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THE SURGICAL TREATMENT OF CLEFT PALATE*

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IN ESTIMATING the incidence of congenital clefts of the lip and palate in public institutions in Baltimore, Dr. John Staige Davis found that such defects were found once in 1170 births. If the rate in New York State corresponds with this estimate, there are about 200 children born here each year with these congenital clefts, or if the same rate is estimated for the entire population of the United States, there would be about 2000 such clefts to record each year.

The unfortunate children who are born with this handicap make a strong appeal to our sympathies. Of course, many of them are deficient in various ways and are not likely to reach maturity. A large proportion, however, are sufficiently strong to have a good fighting chance in the struggle for existence. It is the writer's belief that surgery should offer to them a good prospect of having their clefts closed before speech is established—this applies to clefts in the lip, alveolar process, hard palate and soft palate. Furthermore, the repair of the soft palate should be accomplished with the minimum of injury to its delicate structure, in the hope that it may be long enough to reach the posterior pharyngeal wall and that its muscles may develop satisfactorily and aid in proper phonation. At the present time, this ideal is not attained for a large proportion of these children. The writer believes that it can be attained in much larger proportion and hence, ventures to discuss again this somewhat unpopular subject.

In recent years there has been a definite trend in development of procedures and certain principles may be formulated. We mention the following:

1. Very early operation is desirable.
2. Operation should usually be done in several stages.
3. If there is a cleft in the alveolar arch, it should be corrected before the bones have hardened.
4. Early repair of the lip causes desirable pressure on the premaxilla.
5. In unilateral clefts the sagging of the nostril toward the cleft side should receive careful attention.
6. The flexibility and depth of the soft palate should be preserved with utmost care.

These six principles have been so generally accepted that there is little or no dispute about them. I wish, however, to add a seventh on which

* Read before the New York Surgical Society, November 12, 1924.

authorities differ, but which has been very helpful in my own work, and has greatly improved the results.

7. In restoring the palate, iodoform gauze packing and supporting metal plates are helpful. The iodoform gauze packing supports the muco-periosteal flaps and postpones their union with the palate bones. The metal plates, held by silver wire, help support the muco-periosteal flaps. These two procedures relieve the strain on the median suture line and greatly aid in obtaining firm union.

In discussing these topics, we shall refer to personal observations which have extended over many years; observing and assisting at various cleft palate operations up to 1899, and in the succeeding twenty-five years operating on sixty personal patients with clefts of either the palate or lip or both. This does not constitute a large experience, as we now count surgical operations, but the work was carried through many phases and the improvement in results has been noteworthy.

The operations on the lips themselves have not been difficult. The margins of the clefts have been pared, so as to give broad opposing surfaces of equal or similar length. Strong absorbable stitches have been taken through the mucous surfaces and extending to, but not through, the skin; fine horse-hair or dermal stitches have been used at the skin edges. The suture line has been supported by adhesive plaster or similar support. A little pouting at the lip edge of the incision allows for cicatricial contracture and prevents indentation there. Readjusting operations have been done at later periods when desirable.

The closure of clefts in the hard and soft palates and in the alveolar processes have furnished the real problems. This work may be divided into four periods. 1. The period in which the ordinary Warren-von Langenbeck operation was done by the procedure generally described in the books. 2. The period of Brophy operations. 3. The period of Lane operations. 4. The period in which the principles of the Warren-von Langenbeck operation were used but with the added support of metal plates held by silver wire and of packing of iodoform gauze inserted beneath the muco-periosteal flaps.

1. The first period embraces twenty-seven patients. The average age of these patients was four years and one month. This is late according to our present standard. During this period it was almost always easy to obtain very good looking immediate results. The cleft in the hard and soft palate was usually repaired at a single operation. After paring the margins of the cleft and making lateral incisions, the muco-periosteal flaps were separated from the hard palate and the attachment of the upper part of the soft palate to the posterior margin of the hard palate was cut. The edges of the muco-periosteal flaps and of the soft palate were then brought together and firmly stitched in position. At the end of the operation the result usually seemed ideal. However, there is fundamental weakness in the flaps thus formed. They have deficient support from above, and hence are continually moved by the tongue and by the effort of deglutition; the nasal discharges may interfere

with asepsis; also the union of the muco-periosteal flaps to the bones, from which they have been separated, must occasion considerable traction on the suture line. (See Fig. 6.) Hence, the results of operation were far from satisfactory. The suture line usually held for a week or thereabouts and then a part of it would give way. The ultimate result was sometimes reasonably good, but there was always a feeling that the proper method had not yet been found.

2. The Brophy plan, of compressing the separated bones, has been tried in only two personal cases; the results were also followed in two other cases, which were done by friends. The results were discouraging, but I do not feel qualified to pass judgment on the procedure—my experience has been too small. No on can study the reports of Brophy without feeling that the method has much excellence.

3. The flap hinging operation of Sir Arbuthnot Lane was done in eight cases. The mechanics of the procedure are surely ingenious and practicable. However, the ultimate results were not as favorable for the growth and development of the repaired tissues, as those obtained by the less distorting principles of the Warren-von Langenbeck operation. This was vividly shown in a patient who was presented to this Society, February 14, 1912, by Doctor Mathews.[2] The immediate result was particularly good, so that one could hardly distinguish that there had been a cleft. Doctor Mathews tells me that with the development of the child, the soft palate failed to grow satisfactorily and is now lamentably deficient. At the same meeting, Doctor Downes referred to the shrinking of the soft palate which follows this operation. Berry[3] has called particular attention to the poor power of speech which follows these operations. In view of the results, I do not know anyone who is now doing the Lane operation as a routine procedure.

4. The period in which the principles of the Warren-von Langenbeck operation have been used—and in which the flaps have also been supported by iodoform gauze packing and by metal plates, has been much the most interesting period in this work. During this time, there have been other favorable factors: (a) The children have been brought at an earlier age, sometimes within the first month of life (their average, however, was $11^{9}/_{10}$ months: much too late; (b) the principle of operation in several stages has become more firmly established. James E. Thompson,[4] of Galveston, has especially elaborated the principle—and his deductions are most helpful. George V. I. Brown[5] has also made valuable contributions to this subject.

The most interesting problems which have been studied during this period may be tabulated as follows:

1. Time for primary operation.
2. Sequence of operations.
3. The deformed alveolar process.
4. The deformed nose.
5. Technic of repair of hard palate.
6. Technic of repair of soft palate.

Time for Primary Operation.—The primary operation should be done at the earliest practicable time. The earliest operation in this series was done ten days after birth. Lane [6] thinks that the first few hours after birth form a particularly favorable time for operation, since the infant is still in favorable condition for enduring trauma, a condition which nature has apparently provided to insure safe birth. Sherman [7] prefers the ages of three or four months and a weight of about 15 pounds. Most surgeons will judge the ability of the infant to endure moderate operation and will operate as soon as they believe the child is strong enough to endure a slight operation. It is definitely a question of surgical judgment.

Sequence of Procedure.—The sequence of procedure has been based on

FIG. 1.—Complete cleft of hard and soft palate. Bilateral cleft of alveolar process and lip. Premaxilla displaced forward.

the recommendations of James Berry,[8] who is the especial champion for repairing the lip at the primary operation. He finds that the early repair of the lip leads to " rapid spontaneous narrowing " of the cleft in the palate and alveolus, and he gives pictures [9] of casts which substantiate his claim. This observation has been verified in my own cases. It is also interesting to note that Ritchie [10] in his excellent résumé of the subject, states that " The balance of evidence and opinion is in favor of the lip, palate, sequence in the unilateral alveola cleft operation series."

The reasons for repairing the lip first are twofold. (a) To secure pressure upon the alveolar processes, especially upon the premaxilla. (b) To bring the lip in such position that its development may proceed satisfactorily. It is not absolutely essential that a perfect cosmetic effect should be obtained in the first operation on the lip. Secondary operations here can easily be done at later times, if desirable.

The Problems of the Deformed Alveolar Process and of the Deformed Nose.—One cannot separate the problem of the lip from the problems of the alveolar process and the deformed nose, even in this early primary operation. Although the closure of the cleft in the lip is the most important element of the first operation, this closure should often be accompanied by a correction of the cleft in the alveolar process and a readjustment of the nasal ala. On looking at photographs in Figs. 1 and 2, it is noted that the premaxilla is far in front

of its proper alignment in both unilateral and bilateral clefts. It must receive its share of attention. In bilateral cleft, such as shown in Fig. 1, it is manifest that the lip cannot be repaired until the premaxilla has been brought backward. In this instance, a wedge was taken from the vomer and the premaxilla was forced backward into the maxillary cleft after the opposing edges had been freshened. The lip was then repaired in front of it. Firm union was finally obtained and the alveolar arch was restored, but the intermaxillary portion never developed satisfactorily and the incisor teeth are not good.

The unilateral clefts demand a large share of attention (see Fig. 2). The projecting premaxilla on one side of the cleft and the deficient maxilla on its other side cause unsightly distortion of the nose. Although the pressure of the promptly repaired lip will lead to "rapid and spontaneous" narrowing or even closure of the cleft, the restored alveolar process may be far from perfect and the maxillary bone behind the ala of the nose may still be depressed. The resulting nasal deformity is very disturbing. Experience has demonstrated that in cases of unilateral cleft the lip may be repaired within the first two weeks of life and each successive operation may seem successful, but at the age of eight or ten years, the nose may sag badly on the cleft side and the nostril be flattened and misshapen. It is therefore desirable to pay attention to the projecting pre-

FIG. 2.—Group of children, each having complete cleft of palate and unilateral cleft of alveolar process and lip. In each instance the premaxilla is displaced forward and the maxilla back of the nasal ala on the cleft side is depressed as compared with its fellow on the opposite side.

maxilla and to the distorted nose at the time of the first operation, if it is safe to do so.

Often at the time of the first operation, in addition to repairing the lip, the depressed nasal ala may be cut loose from the underlying maxilla on the cleft side and a cut may be made into the alveolar process and maxilla of the sound side, between the pulps of the canine and lateral incisor teeth. This may be done without materially increasing the severity of the operation. Pressure will then cause a "greenstick" fracture and the premaxilla is thus more easily held in proper alignment. In suitable instances, it may even be further held by a wire suture passed through the soft bones at the margins of the cleft. A silver wire may also be passed from the naso-buccal groove of one side to a corresponding position on the other side. Moderate traction from this wire may be maintained by clamping perforated shot upon it and the depressed nasal ala may thus be held in place, for a time. These procedures aid very greatly in readjusting the nose. In the case whose cast is shown in Fig. 3, the nose is practically normal, the child is even good looking, although its face before operation resembled those shown in Fig. 2. The alveolar arch also is strong and well aligned, both in front and behind. There are several defective teeth in the first denture. It is fair to expect better ones in the second denture. In one instance, I also made a chisel cut within the mouth, into the palate process of the maxilla and the nasal septum, beside the cleft, thus further aiding in mobilizing the projecting premaxilla.

FIG. 3.—Cast made from mouth of child three years of age. At birth he had a complete cleft of the palate continuous with a unilateral cleft of the alveolar process and lip. The lip, alveolar process and nasal ala were adjusted at the age of three weeks. Owing to neglect no operation has been done on the palate. The aveolar arch is well formed and is not too wide at its posterior part. The molar teeth fit those of the lower jaw.

Repair of the Hard Palate.—After the primary effort to restore the lip and so far as possible to correct the alveolar arch and the sagging nose, a certain period may be permitted to elapse before operating upon the palate. This period differs with different patients, and with different operators. Berry suggests waiting two years. Brown advocates operation as soon as the child will endure it. It seems to me desirable to repair the palate within a few months after the primary operation, if the patient is in suitable condition. For in every instance, the sooner the repair is made the greater is the likelihood of obtaining ultimate good results.

The operation on the hard palate itself is a simple one. My present belief is that in many instances, it should be done as one procedure and that the operation on the soft palate should be postponed for a later procedure, thus following the teaching of Thompson and Brown. We all know that we obtain better results in simple soft palate clefts than in clefts which involve both soft and hard palate, also we know that operation on the hard palate may often be done at an earlier age and with better prospect of success than operation on both hard and soft palate at the same time. Hence, it is often desirable to close the hard palate before attacking the soft palate. The delicate structure of the soft palate and its importance in the function of correct speech are the main reasons for postponing operation upon it, until we obtain the best possible conditions for its repair. It should be noted, that there are five delicate muscles in each half of the soft palate, the tensor and levator palati, the palato-glossus, the palato-pharyngeus and the azygos uvulæ. The delicacy of these muscles reminds one of the muscles of the eye or larynx or pharynx. Their structure surely indicates a delicate function. Then the soft palate has the further peculiarity that its posterior margin is free. Hence, it is not strange that most of the repaired soft palates are short; they fail to reach the posterior pharyngeal wall and furthermore they are usually thickened and cicatricial and defective in resiliency. Correct speech cannot be expected under such circumstances. Hence, it is often important that the hard palate should be well repaired before the soft palate is touched, thus endeavoring to obtain the repair of the soft palate at a later operation with the minimum of traumatism or tissue removal.

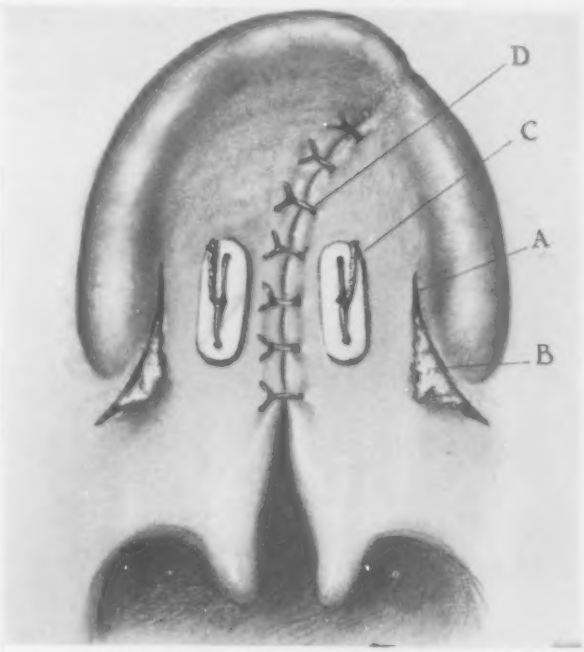

FIG. 4.—Operation upon the hard palate. A. Lateral cuts for relieving tension, aiding in raising the muco-periosteal flaps and providing place for packing of iodoform gauze. They may be placed further forward or may be carried backward and outward across the mandible. B. Packing of iodoform gauze. C. Aluminum plates supported by these strands of silver wire. D. Edges of cleft joined by horsehair or dermal sutures after the removal of a strip of mucous membrane from each margin.

In operating on the hard palate the patient should be put in the Rose position. Ether vapor should be administered through a nasal tube—aspirating apparatus should be available to remove blood and mucus. The operator should wear an electric headlight. The edges of the cleft in the hard palate

are pared, lateral cuts are made near the alveoli and the muco-periosteal flaps are raised. Three pieces of silver wire are then carried from about the middle of one flap across to the corresponding position in the other. They are easily inserted by means of small half circle needles and carrying threads to which their bent over ends are attached. (See Fig. 5.) With the support thus given, it is easy to unite the edges of the cleft in the median line, using horse-hair or dermal stitches. These stitches may be placed "mattress fashion" if one so prefers. A little aluminum plate is then slipped over the wires on

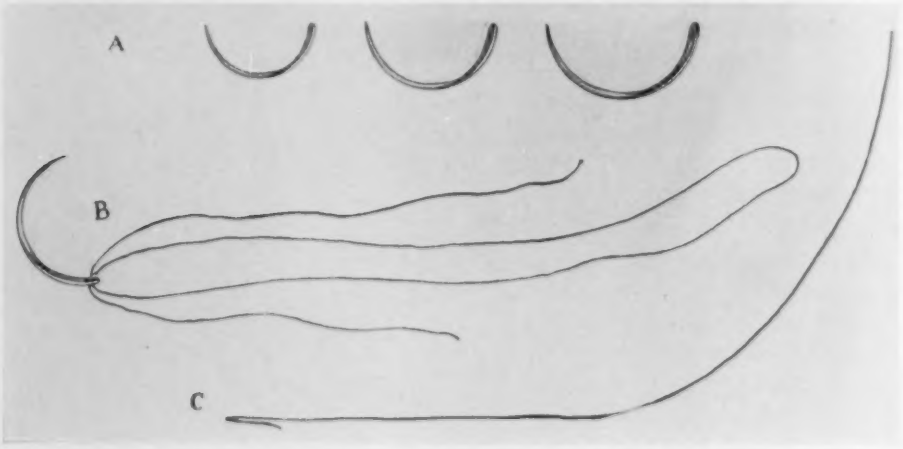

FIG. 5.—A. Lane's needles. They are semi-circular in shape. The smallest one measures one cm. in straight line from eye to point. The shank is strong enough to withstand the pressure of the needle holder. The point is of the cutting variety. Occasionally a Lane's needle holder is desirable for these needles. Usually a slender artery clamp makes a convenient and efficient needle holder. B. Needle armed with "Carrying Thread." C. Silver wire bent at its end. It may be hooked over the loop of the "Carrying Thread" and then is easily drawn through both muco-periosteal flaps.

one side and secured by twisting them. This plate is pulled down into position and another one slipped over the wires on the other side. This in turn is held in position by twisting the wires. Iodoform gauze packing is then put in the lateral cuts. The time for the procedure should be about thirty minutes. There is little loss of blood and little shock to the patient.

The use of the packing and of the metal plates, and even of the lateral incisions, have been discouraged by eminent authorities. Brophy [11] argues against the lateral cuts. Blair [12] objects to the plates because he has found sloughing from their use. He also objects to the packing because he found that it has become foul, and that it may even produce pressure necrosis. Ritchie believes that neither packing nor metal plates are desirable.

I have used aluminum instead of lead plates for over thirty operations and have never seen any slough come from their use. The aluminum plates are lighter than lead. They give sufficient support and they are easily obtained. They can be cut from sheet aluminum which is about the thickness of a visiting card. The support which they give has been very helpful.

In my own cases, the iodoform gauze packing has been more helpful than I would have supposed possible. It is astonishing that it remains so long

without becoming foul. I have even left it in position for eleven days, inspecting it carefully each day. Usually it will stay in position for at least a week, and thus it gives support during the period when it is most needed. After the first gauze is removed, other pieces may be introduced without particular difficulty. The use of this packing is illustrated in Fig. 6. The natural healing tendency leads to the union of the muco-periosteal flaps to the bones from which they have been separated. This process begins at the place of apposition marked E in Fig. 6. Unless the flaps are held away from the bones this union will continue until each flap unites to the bone from which it has been separated. The traction upon the median suture line which results from this healing process must be considerable. If the iodoform gauze packing and the support of the metal plates and their silver wire attachments can postpone this union between the flaps and the bone, we can greatly increase our ability to secure prompt and satisfactory healing in the median suture line. The use of the same devices also aids in securing the proper healing of the soft palate. As to the lateral cuts, I can only say that I tried operating on several cases without them and I have obtained much better results when these cuts are made. They should be close to the alveolar border and can be made either in the anterior or posterior part of the mouth, where they give the most desirable relaxation. During several operations, I tried to preserve the posterior palatine arteries and nerves near the posterior part of the hard palate, but the results were not as good as when these structures were disregarded.

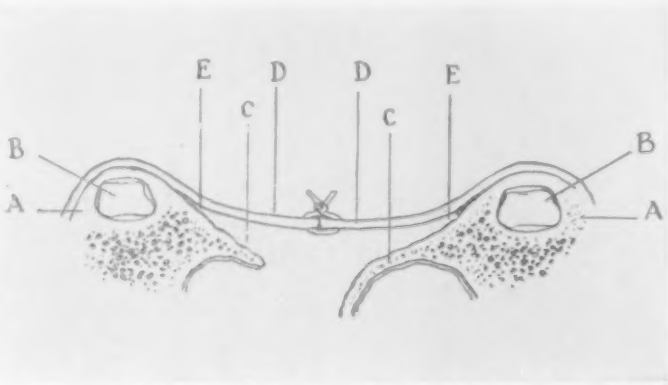

FIG. 6.—Cross-section through the repaired hard palate. A.A. Alveolar processes. B.B. Unerupted teeth. C.C. Palatal processes of superior maxilla. D.D. Muco-periosteal flaps raised from the bone and sutured in the median line. E.E. Angle between bone and muco-periosteal flaps. The healing process tends to reunite these structures at this point. Union progressing steadily inward and causing traction on the suture line.

The muco-periosteal flap may be well elevated at the points where these structures emerge from the palate bones and the flaps still show no evidence of deficiency in circulation or nerve supply. Without doubt, good repair of the hard palate can frequently be obtained even if lateral cuts, metal plates and iodoform gauze packing are omitted, but all these elements have been helpful and I have obtained much better results since they have been used.

Repair of Soft Palate.—The time for operation on the soft palate will depend upon the condition of the patient. The age of one year to one and a half years is probably a fairly good average time, but if other conditions are favorable, a younger child may be successfully operated upon. I have oper-

ated very successfully upon one child at nine months and upon another at eleven months of age. However, Brophy believes that operation on the soft palate before the age of sixteen months "invites failure." It may also be remembered, if the child is not seen until after the most desirable time for operation has passed, the repair may still be done with fair prospect of success.

If conditions are proper, a single operation should be sufficient for the soft palate. The extent of the operation depends on the condition of the tissue. The procedure indicated in Fig. 7 includes all the elements of safety which I have used. If the case is particularly favorable, some of these details may be omitted. The full operation is as follows: The margins of the cleft are pared away. The upper layer of the aponeurotic attachment to the posterior margin of the hard palate is cut. The mucoperiosteal flap is elevated from the posterior part of the hard palate. Lateral cuts are made beside the posterior part of the alveolar processes, and if necessary they are carried backward and outward across the mandible so as to loosen the attachments of the muscles at that place. Interrupted stitches of horsehair or dermal are used for the median line. Supporting metal plates and iodoform gauze packing are used. It is desirable that no secondary operation should be necessary for the soft palate. It is atrophic at best, and each secondary operation means the removal or injury of valuable tissue.

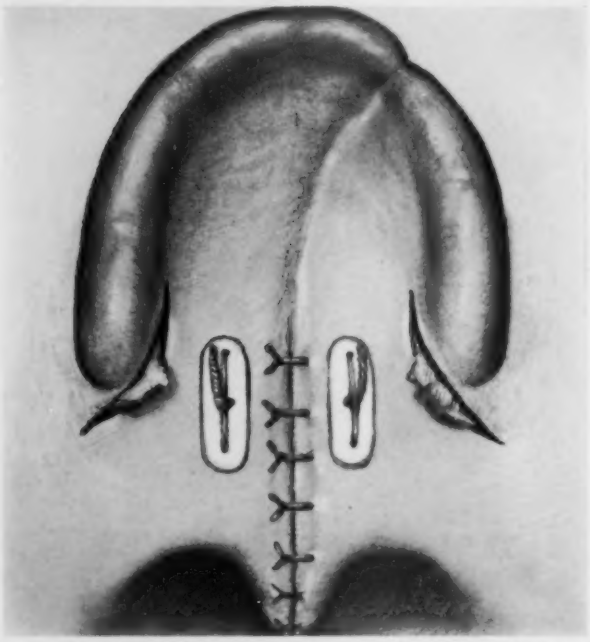

FIG. 7.—Operation on the soft palate. The aluminum plates are placed further back than in the operation on hard palate. The lateral incisions are also carried further back and across the mandible. The edges of the cleft are pared and the fresh surfaces are carefully sewed together with horse hair or dermal stitches.

It is particularly unfortunate to have to pare away repeated strips of tissue from the edges of the cleft. The microscopical examination of these strips shows that they are largely composed of muscle tissue, about four-fifths in the specimens which I have examined. This clearly should not be sacrificed unnecessarily. The primary single paring ought to be sufficient. The wires which are passed through the muscles of the soft palate, of course, make slight scars, but they are so slight that they do not counteract the benefit which the wires and metal plates give. The lateral cuts and packing and the cuts at the

posterior margin of the hard palate are all outside of the delicate muscles of the soft palate.

Occasionally a healthy child gives opportunity for very early and successful operations. The sequence for the infant whose photograph is the first one at the left in Fig. 2 was as follows: (1) Lip, alveolar process and ala of nose when twelve days old. (2) Hard palate when three months old. (3) Soft palate when nine months old. (4) Readjustment of lip and re-correction of nasal deformity when twelve months old. This is the earliest case which I have done and the result is particularly satisfactory. I do not believe so early a repair of the soft palate can be advised as a routine procedure, but I do believe that it is advantageous to obtain this early repair when it can be done with safety.

Speech.—It is noted that all the time we have been working to obtain a proper healing of the clefts before speech is really established. How shall we obtain the best possible speech? This now becomes the pressing problem. If we have succeeded in the early repair of the soft palate, so that it is long enough to reach to the posterior pharyngeal wall and so that it is soft and its muscles in reasonably good condition the resulting speech should be good.

Usually the mother can teach the child to speak better than anyone else. She is with the child continually and takes an interest which can not be expected from any other teacher. Her efforts, however, should be directed by someone who is especially skilled in the correction of speech defects. Hence, I believe that the mother should take each of these children to such an expert as soon as speech begins. Furthermore, we are still continually dealing with patients who come after the most advantageous period for operation has passed, but special instruction will still be very helpful for such patients. The persistent practicing of the difficult consonants should be continued through years. Blair says that the greatest difficulty is in distinguishing the nasals from the mutes, *e.g.*, P-B from M, and believes that when the beginner can properly pronounce STARK and CAR, he has the key to the situation.

Nasal Deformity.—The problem of the nasal deformity is one of the most difficult in the entire perplexing series. Some of the details have already been referred to. The proper establishment of a good alveolar arch and a good hard palate and a good lip are the main elements in relieving the nasal deformity, but if the maxilla of the cleft side is still depressed as compared with its fellow on sound side, absolute symmetry of the nose cannot be expected. The loosening of the nasal attachment and the pulling of the ala forward and toward the midline by a wire which is held by clamped shot is surely helpful, but these measures do not always solve the problem.

Blair suggests a plastic operation on the floor of the nostril also in advanced cases traction on the vomer or nasal bone by means of a wire, which pierces the soft tissues and is attached to one of the bicuspid teeth. I have had no experience in these procedures.

Summary.—In making a summary of the principal topics which have been raised in this paper, I would say:

1. These children should have their defects repaired by the time speech is established.

2. The operation on the lip should be done at the earliest practicable time.

3. In many instances, correction of the alveolar process and of the nasal deformity may be begun at the same time with the lip operation.

4. The hard palate should ordinarily be repaired a few months after the primary operation on the lip and alveolar process.

5. Metal plates and iodoform gauze packing are helpful in securing a good result.

6. Usually the operation on soft palate should not be done until the hard palate has suitably united.

7. The soft palate should be protected from traumatism and no tissues should be removed excepting the small margin of the cleft. This repair should be accomplished at a single operation. It is the most delicate structure with which we have to deal. It should be conserved to the fullest possible degree.

8. Speech instruction should be begun early and carried out persistently and carefully under skilful direction.

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CERVICAL SYMPATHECTOMY FOR ANGINA PECTORIS*

By J. Louis Ransohoff, M.D.
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If the function of medicine is to relieve pain, there is no condition which is more worthy of our efforts than angina pectoris. The mere name is sufficient to describe the terrific pain which the sufferer from angina experiences. Although the individual attack may be ameliorated by morphia and nitroglycerin, medicine is in many instances unable to prevent the recurrence of the attacks. The sufferer from severe angina lives not only under the constant shadow of impending death, but what is worse, with the knowledge that he will experience recurrent attacks of pain, so terrifying, that death can only be a relief.

In order to understand the surgical treatment of angina pectoris, it is essential that there shall be an understanding of the pathology and of the physiological path through which the pain is carried from the seat of the disease to the central nervous system. There are several views of the pathology of angina pectoris. According to some observers, among whom is Sir James Mackenzie,[1] angina is due to a sclerosis of the coronary arteries. In ordinary health the coronary arteries are distensible and during hyperactivity of the heart, dilate to carry the larger amount of blood demanded by the increased muscular effort. If this distention of the coronary vessels cannot occur, as in coronary sclerosis, then the heart muscle acting under a comparative anæmia, causes severe pain. The principal argument against this theory is, that while most old people show at autopsy, a high degree of coronary sclerosis, comparatively few suffer during life from angina. While many who have died of angina, show at autopsy, little or no evidence of coronary sclerosis.

According to Albutt,[2] whose theory seems more tenable, angina is due to aortitis, either syphilitic or inflammatory, and the pain is due to stretching of the adventitious coat with its unstriped muscle fibre.

In 1899, Franck,[3] after a study of cardiac innervation, first suggested a division of the cervico-thoracic sympathetic as a method of stopping the pain of angina pectoris. The theories which he elucidated are still valid. He showed that the predominant rôle was played by the transmission of the pain through the cervico-thoracic chain to the central nervous system.

The heart and aorta like the abdominal viscera carry on their function during health without appreciable sensation. It is only in disease that visceral sensation is transmitted to the central nervous system in the form of pain. The heart and large vessels are supplied by two antagonistic autonomous nerve systems; the sympathetic and the para-sympathetic or vagus. The sympathetic nerves for the heart and large vessels arise in the cervical

* Read before The Western Surgical Society, December 4, 1924.

and upper thoracic ganglia of the sympathetic, that is the cervico-thoracic chain, and pass to a plexus of nerves situated at the root of the aorta, where they anastomose with the terminal fibres of the vagus nerve in the plexus of Wrisberg. The ganglia are in turn connected to the spinal cord by the rami communicantes which enter the spinal cord through the posterior roots of the eighth cervical and first four dorsals. This communication accounts for the transmission of the anginal pain to the thorax and the arm.

Understanding the physiology of the transmission and the reference of pain in angina, the theory of Franck seems logical. It was only surprising that it was nearly twenty years later that Jonnesco [4] did his first cervico-thoracic sympathectomy for the treatment of angina.

In planning his first case Jonnesco believed that it would be necessary to perform a bilateral sympathectomy for the complete relief of the anginal attacks. However, looking over his own and other cases which have been clinically cured through the unilateral operation, he has come to the later conclusion that this will suffice in nearly all cases. This is further borne out by the clinical observation that nearly all cases of anginal pain are limited to the left side.

Albutt reports only one case in which the pain was limited to the right side, while Morrison [5] reported another case in which post-mortem revealed the aortic side free from disease, while the pulmonary valve and the base of the pulmonary artery showed unmistakable evidence of sclerosis.

Jonnesco insists, however, that the operation must include the complete resection of the superior cervical, middle and stellate ganglia, which latter is composed of the fusion of the lower cervical and the first thoracic ganglia.

In contra-distinction to his views, Coffey and Brown [6] have treated five cases by the simple division of the cervico-sympathetic cord below the superior cervical ganglion and above the origin or rather the entrance of the superior cardiac nerve. In two cases they achieved clinical cures, while in two others, some pain in the left arm persisted. Whether the simple operation of Coffey and Brown will suffice, only further observation can show. It seems, however, logical to believe that the more radical operation of Jonnesco will prove of greater value, as the principal avenues of cardiac and aortic sensation seem to be derived from the inferior cardiac nerves, which enter the cord at the stellate ganglion, rather than the superior, which enters the cord just below the superior cervical ganglion.

It is not only the relief of pain which recommends operation for angina pectoris, but the well-known clinical observation that death usually follows an unusually severe attack of anginal pain. This is well explained by Albutt, who says that the sudden death from angina is due to vagus inhibition, as a result of the pain transmitted through the sensory fibres of the sympathetic nerve. Therefore, if this arc is broken, it is possible that in some cases a fatal outcome may be indefinitely postponed.

The cases for operation must be most carefully chosen. It is almost axiomatic that no case should be treated surgically which can be controlled by

medical treatment. In the presence of positive syphilitic history, or a positive Wassermann, active anti-syphilitic medication should precede operation. Brilliant results can be achieved in that class of cases where the angina is the dominant symptom, and where there is no marked cardiac decompensation. If the latter is present, in great degree, operation should not be undertaken as it is certainly doomed to failure.

Jonnesco performed the operation in two cases of advanced cardiac decompensation with pulmonary œdema and general anasarca. In both instances death followed within a few days. In four other cases, free from marked decompensation, operation was followed by clinical cures. That is the complete freedom from anginal attacks. Brilliant results of cervical sympathectomy for angina have also been recorded by Halstedt, Von Pleth, Coffey and Brown, Bruening, Tiffuier.

In February, 1924, Seneque [7] collected 23 cases in which operation was done. Five of these cases died as a result of the operation and one died several weeks after operation of broncho-pneumonia. Of the remaining seventeen cases, six were too recent to judge the definite result. Of the other eleven, two in which the incomplete operation of Coffey and Brown was done were definitely improved, while the remaining nine were reported as clinically cured, that is a complete freedom from attacks. The mortality which seems high is increased by the two cases of Jonnesco, which were unwisely operated on during attacks of marked cardiac decompensation, pulmonary œdema and general anasarca.

The indications for operation are these: 1. Angina pectoris which cannot be controlled by medication. 2. If an organic heart lesion is present, it must be well compensated. 3. The younger the individual, and the more severe the attacks, the more urgent is the operative indication. As these cases are in most instances bad anæsthetic risks, the question of anæsthesia is worthy of serious consideration. As a rule they have increased blood-pressure and in the majority of cases organic valvular disease, aortic sclerosis and hypertrophied hearts.

Jonnesco operates under a high spinal anæsthesia. Though this has proven satisfactory in his hands, it does not appeal to the American surgeon. The majority of other operators have used general anæsthesia. In my experience, sympathectomy can be performed under the ordinary infiltration local anæsthesia as readily as goitre surgery. One per cent. novocain is used, but without adrenalin, which in cases of high blood-pressure may prove dangerous. In both of my cases the operation was done under local anæsthesia, with comparatively little pain. If at any stage the pain is severe, light gas anæsthesia may be superinduced.

The operation is described by Jonnesco as delicate rather than difficult. The steps are as follows: A long incision is made along the posterior border of the sterno-cleido-mastoid muscle from the mastoid tip to the clavicle. The external and jugular vein is doubly ligated and cut. The muscle is either split along its posterior border or dissected free from its fascia. During this

stage the spinal accessory nerve is identified and held out of the way. Meticulous hæmostasis with ligation of the individual vessels is essential as the operation progresses. If the field becomes blood-stained identification of land-marks becomes difficult and the completion of the operation may be rendered impossible.

The muscle and the underlying neuro-vascular bundle consisting of the carotid artery, the jugular vein and the vagus nerve are retracted sharply forward with broad retractors. At this stage of the operation an experience of Brochard [8] points a possible danger. This case died a week following operation with right hæmiplegia, which he ascribes to interference with the circulation in the common carotid artery during operation from too forcible retraction. In the upper angle of the wound, lying in relationship to the internal carotid artery, the superior cervical ganglia is identified as fusiform in shape and covered by a thin translucent fascia. The cord can also be identified at the level in the sixth cervical vertebra, by its relationship to the inner side of the inferior thyroid artery. With these two guides, the sympathetic trunk is isolated with a grooved director from one end of the wound to the other. The superior ganglion is grasped with hæmostatic forceps and with the finger the ganglion is freed up to the base of the skull. The branches of the ganglion are cut with blunt-pointed scissors and with a sudden jerk from above downward the ganglion is torn from its cranial attachments. The middle cervical ganglion is then isolated from the inferior thyroid artery. Sometimes the ganglion lies in front of the artery, sometimes the ganglion bifurcates and the artery passes between the two ganglionic masses and sometimes there may be two ganglions—one above and one below the artery. The latter is carefully isolated from the ganglion by cutting the periarterial nerve branches. There remains the inferior cervical ganglion and sometimes an intermediate ganglion. After liberating the latter, the inferior ganglion is sought. It lies in a space bounded by the transverse process of the seventh cervical vertebra and the first and second ribs. The transverse pleural ligament and the superior intercostal artery lie externally, the vertebro-pleural ligament internally and the vertebral artery and vein in front. At the entrance to the thorax, several branches must be cut to free the cord; the middle cardiac branch, which is relatively superficial, and the branch directed toward the subclavian artery. The inferior ganglion is then grasped with forceps and drawn forcibly forward, the tissues about are freed with the index finger, and the ganglion, with a sudden pull is freed from its attachments. In this dissection there is a possibility of injuring the vertebral vein, or artery, the superior intercostal artery, the jugular vein or the dome of the pleura. The wound is closed without drainage.

Case I.—Male, aged fifty-two, referred by Dr. H. B. Weiss. Admitted to the Jewish Hospital, February 16, 1924. Complains of pains in the chest, left arm and back, and shortness of breath. He first consulted Doctor Weiss for this condition in April, 1923. At that time he was suffering with exceedingly severe attacks of angina pectoris, which were relieved only by the administration of morphia. These attacks occurred at various

intervals, sometimes daily, sometimes once or twice a week, and the condition has remained unchanged to the present time. For the seven years preceding these attacks he had been suffering from high blood-pressure, for the relief of which he had consulted various doctors.

Examination: Adipose male, weight 210 pounds, ruddy complexion, veins of the neck distended, patient assumes an absolutely stolid attitude, and says that he is afraid to move, for fear of bringing on an attack. There is evident dyspnœa.

Physical examination: Heart measures 11 x 3 cm., rate 84, regular, no murmurs. Blood-pressure 160/98. Electrocardiogram shows hypertrophied heart. Seven-foot radiograph shows enlargement of the left side of the heart, dilatation of the aorta. Pulmonary examination negative. Wassermann negative. Urinalysis, faint trace of albumin, otherwise negative. Phenolphthalein test 27 per cent. in the first hour.

Diagnosis.—1. Angina pectoris. 2. Arteriosclerosis. 3. Myocardial degeneration. 4. Dilatation and hypertrophy of the heart.

During the three weeks subsequent to admission, the patient's condition remained unchanged. In spite of the rest there were frequent attacks of angina, which were relieved by codine or morphia. It was therefore decided to do a cervical sympathectomy.

Operation.—March 10, 1924, under local anæsthesia, 1 per cent. novocain, a typical cervico-thoracic sympathectomy was done. The operation was without incident, the patient complained of severe pain only at the moment of evulsion of the superior cervical ganglion. At that moment the right pupil dilated widely and then became sharply contracted. Following operation there were no untoward symptoms. The usual enophthalmos and slight redness of the conjunctiva on the left side developed. There was no irregularity of the pulse, no evidence of cardiac decompensation. During the few days subsequent to operation the blood-pressure in the left arm was comparatively higher than that in the right. The patient was out of bed a week following operation, and was discharged on the fourteenth day. He was last examined by Doctor Weiss, October 23, 1924. He says that he has been enormously relieved by the operation in that the attacks of angina have absolutely ceased. He is now able to move freely without fear of an impending attack, and for the first time in two years is able to resume his occupation; that of tailor. He has been put on a diet and has lost 26 pounds. There is still some dyspnœa on exertion, and an occasional sense of weight in the precordium. The dyspnœa, though not as severe as before operation, is, of course, due to the cardiac insufficiency, and will always persist. The blood-pressure at this time was 150/110.

Case II.—Female, aged fifty-three, referred by Dr. M. Wallenstein. Admitted to the Jewish Hospital, June 10, 1924. Her chief complaint is severe attacks of pain in the heart, radiating down the left arm. She has suffered from these attacks of pain for the last five years. These attacks come on at varying intervals, from several times a day to once or twice a week. At times they have remained absent for a month. During these attacks she has the sense of impending death. She describes the pain as gripping and radiating down the left arm to the finger tips. The attacks are at times relieved by the administration of amyl nitrate and at times require morphia. Denies venereals.

Physical Examination.—Rather corpulent female, no thyroid enlargement, dilatation of the cervical veins and evident carotid pulsation. There is slight dyspnœa on exertion.

Cardio-vascular.—Heart enlarged, slight systolic murmur heard over the apex and base, but not transmitted. The apex beat is palpable at the fifth interspace, 12.5 cm. to the left of the middle line. Measurement at the third interspace 5 cm. to the right of the middle line, 7½ cm. to the left. Blood-pressure 227/115.

Seven-foot X-ray.—Hypertrophy of the heart, dilatation of the aorta. Wassermann negative.

Diagnosis.—1. Hypertension with arteriosclerosis. 2. Cardiac hypertrophy; possible mitral insufficiency. 3. Angina pectoris.

During the week before operation in which the patient was in the hospital, there were several attacks of angina.

June 17, 1924, under local anæsthesia, 1 per cent. novocain, a left cervico-thoracic sympathectomy was done. The operation was without incident. On the day following operation, there was enophthalmos, slight reddening of the conjunctiva and contraction of the left pupil. The patient was out of bed on the fifth day following operation and was discharged from the hospital on the fourteenth day. During this time there were no anginal attacks.

Examination October 26, 1924, slight enophthalmos, and narrowing of the left palpebral fissure. Blood-pressure 198/120. There is still dyspnœa on exertion and at times a sense of fulness in the precordial region. Since the operation there has been a complete freedom from attacks of angina.

Conclusion.—These cases show that attacks of angina pectoris may, in certain cases, be prevented by left cervico-sympathectomy. Naturally the cardiac disease and the hypertension are not influenced. However, the patient's life may be made comfortable, which seems a great advance.

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THE SURGICAL TREATMENT OF ANGINA PECTORIS*

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Introduction.—Certain definite functions have, for a long time, been ascribed to the sympathetic nervous system: the nervous control of the thoracic and abdominal viscera; the innervation of all smooth muscles, especially those of the blood-vessels, hair and pupils; and the secretory action of glands, notably the sweat, salivary and ductless glands. These functions may, in the main, be accepted as proven.

There are many human ailments which may conceivably be due to or accompanied by disturbances in function of this system. For example, epilepsy, migraine, glaucoma, neuralgias, exophthalmic goitre, various spasms of the alimentary tract, and peripheral vascular affections such as Raynaud's disease have been assumed to be caused by an abnormal function of the sympathetic nerves. On this basis Jonnesco has excised the cervical sympathetic chain many times for epilepsy, glaucoma and exophthalmic goitre. Sluder has treated successfully certain types of neuralgias by attacking the sphenopalatine ganglion. Leriche and many others have done peri-arterial sympathectomies for various peripheral vascular disturbances, notably Raynaud's disease and trophic ulcers following lower cord lesions.

The idea has been extended further and excisions of the sympathetic nerves have been done for conditions not thought to be due to affections of the sympathetic nerves but which, it was reasonable to suppose, could be helped by an increased blood supply. For instance, periarterial sympathectomies have been and are being done for chronic ulcers, threatened arteriosclerotic gangrene, ischæmic contractures, ununited fractures, surgical tuberculosis, etc., in the hope that there would result a peripheral vasodilatation that would affect favorably these conditions by increasing their blood supply.

The results of these various surgical attacks have not been conclusive enough to convince the surgical and medical professions that they are of great value. Good things usually weather the author's enthusiasm and stand the test of time. Sympathectomy for epilepsy, glaucoma, exophthalmic goitre and neuralgia cannot be said to have done this. With periarterial sympathectomy there is more promise for its acceptance as a procedure of considerable value.

The operation to be discussed in this paper has, by no means, been subjected to the test of time. Although Francois Frank suggested it some

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twenty-six years ago, it is just eight years since Jonnesco first performed a cervicothoracic sympathectomy for angina pectoris. All told, we have found reported only fifty cases of angina pectoris treated by operations on the sympathetic nervous system, a number too small to establish its value. In this paper all we hope to do is to set forth the various proposed reasons for doing sympathectomies for angina pectoris and to state as accurately as possible the results to date.

Anatomy.—In order to understand the various reasons that have been advanced to justify the operation of sympathectomy for angina and to explain its beneficial effects it will be necessary to review briefly the innervation of the heart and aorta. The main nerve supply is derived from the superficial and deep cardiac plexuses which receive nerves from all the cervical and from the first (and possibly second) thoracic sympathetic ganglia, and from the vagus nerves. None of the cervical spinal nerves contribute preganglionic (or white rami) fibres to the sympathetic nervous system. Thus all of the cervical and the upper thoracic ganglia are supplied with preganglionic fibres that arise from the upper dorsal spinal nerves and travel along the sympathetic cord for varying distances before terminating about the nerve cells of the ganglia. Such an arrangement, however, does not hold for the post-ganglionic (or gray rami) fibres, for every spinal nerve receives a branch from the sympathetic chain and practically all (especially the third, fifth, seventh, ninth and tenth) cranial nerves receive post-ganglionic connections from the superior cervical ganglion. Thus the sympathetic system, in addition to its distribution to the thoracic and abdominal viscera, reaches out to all those vast regions supplied by the somatic nerves.

It may be well to recall to mind that the true sympathetic nerves are efferent or motor, supplying stimuli that result in activity of the smooth muscles, the cardiac muscles and the glands. Hitherto it has not been supposed that there were any true sympathetic fibres that conducted afferent or sensory impulses. We mention this as there are recent observations coming from this country and Australia which indicate that the sympathetic nerves influence profoundly the sensory and motor functions of the somatic nerves if, indeed, they themselves do not conduct sensation.‡

‡ Reference is here made to the recent contributions from Australia where spastic paraplegia has been treated by operation on the sacral autonomic system; to the recent work of Pavlow who has shown that a tired somatic muscle can be revived by stimulating the sympathetics and that the trophic nerves are separated from the functional and vasomotor nerves and are contained in the sympathetics; and to the experience of one of us (Reid) with wide-spread sensory and motor disturbances following cervico-thoracic sympathectomies for angina pectoris.

Pavlow has demonstrated that all striped muscle has a sympathetic inervation. He believes that in the heart muscle the sympathetic nervous system produces physical and chemical changes which express themselves in an alteration of the properties of the muscle—increase in irritability and of strength and height of contraction, increased excitability and conduction, a shortening of the period of refractability, etc. He also thinks that the same functions, though less marked, are exercised by the sympathetic nerves over the skeletal striped muscles.

In the previous paragraphs the term true sympathetic nerves has been used, for we wish to point out the fact that there are so-called splanchnic afferent nerves which conduct sensations from the heart and other viscera to the spinal cord and thence to the brain. These are generally conceded to be somatic sensory nerves with their ganglionic cells situated in the posterior root ganglia. They simply travel with the sympathetic nerves. So far as the heart is concerned, there can be this difference between the lines of travel for its motor and sensory impulses. The former come from the central nervous system by way of the upper thoracic spinal and vagus nerves, whereas painful cardiac sensations may travel to the central nervous system by way of any of the cervical or upper thoracic spinal nerves and the vagus nerves.

FIG. 1.—Case 25. Left sympathectomy, including the entire cervical chain and stellate ganglion. The depressor nerve was probably sectioned while removing the nerve filaments mesial to the main trunk.

Theories of Angina Pectoris.—There are many theories as to the etiology of the pain and sudden death in angina pectoris. Some of them are: (1) The severe pain is due to an aortitis and the sudden death to a reflex inhibition of the heart through the vagus nerve (Albutt). (2) The pain and the death are due to a marked vasoconstriction causing an irritation of the sensory nerve endings in the heart and an anæmia of the cardiac centres in the medulla oblongata. This explanation assumes, as is probably true, that splanchnic efferent fibres enter the spinal canal and accompany the blood-vessels supplying the cord and medulla. (3) A spasm of the coronary vessels produces pain and death by causing a local anæmia. This explanation is comparable to the pain and muscular inaction in cases of intermittent claudication. (4) A spasm of the coronary vessels causes severe pain which may lead to a reflex sudden death by cardiac inhibition through the vagus nerve. (5) Diseases of the coronary vessels, such as sclerosis and angiitis, cause pain which may reflexly stop the heart. (6) The pain is due to an over-distention of the coronary vessels and the sudden death a reflex from it. (7) Embolism and thrombosis. (8) Pathological conditions of the heart muscle. It is not the purpose of the present article

to discuss the various arguments for and against these theories, such as: the existence or non-existence of vasoconstrictor nerves to the coronary and cerebral vessels, the antagonistic action of the peripheral and coronary circulation, etc., for, very little would be gained from such a discussion. They are subjects that have been discussed for many years and we can bring no new work nor observations that will help to solve these questions. Perhaps, there is some truth in all the proposed theories.

Viewpoint of the Surgeon.—In view of the great divergence of opinion among internists as to the etiology of angina pectoris, the surgeon is confronted with the problem of countering with as many theories in order to justify his procedure or of ignoring the etiology. The latter course is simpler and for the present, probably wiser. The surgeon's viewpoint may be summed up as follows: (1) The pain impulses of angina pectoris are conducted by the parasympathetic and sympathetic afferent fibres. (2) The sudden death is due to the action of the efferent fibres. (3) Is it justifiable to attempt to relieve the pain and avoid the sudden death of all or any special types of angina by resecting the innervating fibres to the heart? Theoretically and practically, it seems possible to section these nerves. It is argued by many that anginal attacks are always due to serious cardiac pathological lesions and that a freedom from pain will hasten the progress of these lesions. In answer to this it is pointed out that there do occur typical cases of angina pectoris where the internist, the physiologist and the pathologist fail to find extensive pathological changes in the heart. Also, if the pain is due to diseases of the aorta and heart, it does not necessarily follow that this pain should not be stopped, for the sudden death in any case is likely due to a reflex spasm of the heart. Suppose, too, that with the absence of pain the cardiac diseases should progress, the ultimate fate would likely be a decompensated or exhausted heart which would be easier to treat than the pain and likelihood of sudden death. Wenckebach, in speaking of the pain of angina pectoris, has pointed out that many of our defense reactions possess possibilities of becoming themselves injurious. He cites the well-known serious consequences of referred pain, pyrexia, high blood-pressure and tachycardia. It has also been shown by Danielopolu that pathological afferent impulses can bring about a discharge of efferent impulses which have a damaging effect upon the heart and blood-vessels. That the explosive intense pain of angina falls into this class of pathological afferent impulses no sufferer, we feel, would question. Indeed it is well known that the heart does often suffer damage with each attack of severe pain. We agree with Wenckebach that this theoretical objection to a relief of the pain should not prevent us from operating if a sympathectomy will relieve the pain.

Results.—In the present state of our ignorance, both with respect to the etiology of angina and the true function of the autonomic nervous system, judgment as to the value of any given therapy for angina pectoris is largely of academic interest. The question cannot be settled by discussions based

TABL

Cases of Sympathectomy

Case	Author	Publication	Color	Age	Sex	Duration of disease	Aortitis. Art. sclerosis. Syphilis	Condition of heart	Nature of attacks	P
1	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	38	Male	3½ months	Wassermann positive	Heart and aorta slightly enlarged. Slow pulse. Extra systoles	Five attacks prior to operation. Occur night and day. Typical angina	Anti me
2	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	54	Male	8 years	Wassermann positive	Heart hypertrophied. Systolic murmur at base	Very frequent typical attacks of angina at least two a day	Anti
3	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	23	Male	8 months	Aortitis. Wassermann negative	Heart normal in size. Sounds clear	Attacks occurred on effort. No attacks when resting. Attacks typical of angina	Rest
4	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	..	Male	12 years	Wassermann positive	Normal in size. Sounds clear. Enlarged aorta	Attacks came so frequently that he was totally incapacitated	Anti op
5	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	42	Male	8 months	No information	Myocarditis with œdema of legs and enlarged liver. Markedly enlarged heart. Pulmonary œdema	Attacks 20 to 30 times a day	No i
6	Jonnesco.....	Le sympathique cervico-thoracique. Masson; Paris, 1923, p. 70	White	35	Male	10 years	Wassermann positive	Enlarged. Cardiac murmurs. Myocarditis	20 to 30 attacks in 24 hours	Ant me
7	Tuffier.....	Bull. Acad. de Méd. Par., 1921. Series 86; p. 70	White	50	Male	Not stated	Arterio-sclerosis	Not stated	Intractable pain. Pain became unbearable	Not
8	Bandier, H., Minet, J., Sevyngedauw and Legrand, R.	In Jonnesco. Le sympathique cervico-thoracique. Masson, 1923, pp. 76-77	Not		stated	Not stated	Aortitis	Not stated	The angina was associated with a marked trigeminal neuralgia	Not
9	Bruning, F., Kohler, R., and Von der Weth, G.	Arch. f. Klin. Chir., 1923. Vol. 126, p. 484. Zeitschr. f. Klin. Med., 1924. Vol. 99, p. 215	White	59	Female	12 years	Wassermann positive. Arterio-sclerosis	Moderate hypertrophy. Sounds clear	The pain was severe and typical of angina	Vigo me
10	Danielopolu, D., and Hristide	Compt. rend. Soc. de Biol., Vol. 88, 1923, p. 271	Not		stated	Not stated	Not stated	Not enlarged	Severe attacks, 10 to 20 per day; brought on by the slightest exertion	Not
11	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med., 1923, Vol. 31, pp. 200–201	White	51	Male	3 years	Wassermann negative	Slight cardiac hypertrophy with probable myocardial changes. Extra systoles	Attacks became as often as 6–8 per day. Exertion provoked attacks	Rest car tal mo
12	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med., 1923, Vol. 31, pp. 200–201	White	62	Male	5 weeks	Wassermann negative	Hypertrophy and dilatation. Pulse deficit 42. Wide aortic area. Myocarditis	Attacks daily or every 2–3 days. Some at night. More frequent on exertion, twenty attacks in all	Rest
13	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med. 1923, V. 31, pp. 200–201	White	24	Male	8 days	Wassermann negative	Decompensated, auricular fibrillation. Orthopnœa. Œdema of legs	Only 2 severe attacks; first lasting 21 hours; 2nd 8 hours. Some minor pains in arm and neck	Rest
14 1st adm.	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med., 1923, Vol. 31, pp. 200–201	White	54	Male	8 years	Wassermann positive	Enlarged. Mitral stenosis and insufficiency. Aortic insufficiency. Wide aortic arch. Beginning aneurism	Constant substernal pain recently, and severe radiating attacks of pain on the slightest exertion	Muc wit
14	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34,						Auricular fibrillation	Attacks recurred 20 mo. after	Seco

TABLE I.

...ectomy for Angina Pectoris.

	Pre-operative treatment	Operation	Anæsthetic	Latest observation after operation	Result	Blood-pressure		Remarks.
						Pre-operative	Post-operative	
...era-...day.	Anti-luetic treatment with mercury	April 2, 1916. Excision of the two last cervical and first thoracic ganglia on left side. March 31, 1922. Same operation on the right side	Spinal anæsthesia. Stovain and strychnia	7 years	Well	Not	stated	The patient returned to original work as a singer and court functionaire. The second operation was not performed because of pain. He had had no pain since the first operation.
...at-...two	Anti-luetic treatment	June 13, 1921. Excision of entire left cervical chain and stellate ganglion	Stovain and strychnia	18 months	Well	Not stated	23/7 Pachon scale	Has a transient pre-cordial pain if he works too hard "probably not angina". Returned to original work.
...ort. ...ing. ...a	Rest	Feb. 17, 1922. Bilateral excision of entire cervical chain and stellate ganglion	Stovain and strychnia	18 months	Well	Not	stated	Returned to work as a wood cutter.
...ntly ...in-	Anti-luetic treatment after operation; not before	Oct. 16, 1922. Left cervico-thoracic sympathectomy. Oct. 23, 1922. Same operation on the right side	Stovain	3 days	Not stated	Not	stated	Three brothers died from angina. Ages 40, 45 and 47. This patient died eight months after operation. The author does not know if the operation gave relief from pain, for he was unable to follow the case. In this case the surgeon could not remove the entire stellate ganglion on either side.
...day	No information	May 11, 1922. Left complete cervico-thoracic sympathectomy	Stovain	4 hours	Death	Not	stated	Death occurred four hours after operation.
...ours	Anti-luetic treatment with mercury and iodides	May 13, 1922. Left total cervico-thoracic sympathectomy including first and second thoracic ganglia. May 24, 1922. Same operation on the right side	Stovain	15 days	Dead	Not	stated	Improved after first operation. Death four days after second operation, due to cardiac decompensation.
...a be-	Not stated	July, 1921. Excision of last cervical and first dorsal ganglia	Ether	2 days	Relieved of pain	Not	stated	Some apnœa and irregularity of the pulse while pulling on the stellate ganglion during operation.
...iated ...ninal	Not stated	December, 1921. Resection of cervico-thoracic chain on both sides, done at an interval of a few days	Not stated	1 month	Unimproved	Not	stated	Although Jonnesco includes this case under angina pectoris it is difficult to tell if the operation was done for angina or neuralgia. It seems that the neuralgia was the most marked.
...and	Vigorous anti-luetic treatment for a long time	January 16, 1922. Removal of lower pole of superior cervical ganglion and sympathetic chain down to and including stellate ganglion. Cardiac branch of superior cervical ganglion was divided	Ether	8 months	Well	145/220	Lower	Patient had Raynaud's disease of both feet. Peri-arterial sympathectomy done twelve days before the operation for angina. Histological study of the stellate ganglion showed a progressive degeneration of nerve cells associated with a chronic inflammatory process and a connective tissue proliferation. Authors believe that the pain and sudden death in angina are due to a spasm of the coronary arteries and a cramp of the heart muscle.
...o per ...y the	Not stated	1922. Resected dorsal root of second thoracic spinal nerve	Local	Not stated	Improved	Not	stated	By repeated experiments during which they put their patient through violent exercises, they proved that injection of the first and second dorsal roots with procain completely relieved the pain. This led them to do the operation.
...en as ...a pro-	Rest and general medical care with the use of digitalis and nitrites for six months	Nov. 30, 1921. Division of trunk below superior cervical ganglion and section of upper cardiac nerve	Ether	1 month and 4 days	No pain	160/80	115/70	Patient continued to have angina in the form of substernal pressure (not pain), especially on exertion.
...y 2–3 ...More ...rtion,	Rest digitalis, nitrites	December 9, 1921. Division of trunk below superior cervical ganglion, and of superior cervical cardiac nerve	Gas and oxygen	5 months	Well	240/130	145/110	One very mild attack two weeks after the operation, but no others. Marked cardiac disease with dropping of beats, dilatation, etc. A definite drop in blood-pressure occurred after operation.
...; first ...nd 8 ...ains in	Rest, digitalis, etc.	Feb. ...1922. Division of the main trunk below superior cervical ganglion,	Procain	12 days	No pain	130/90	110/70	During operation it was noted that sponging of superior cervical ganglion caused pain in the supra-orbital region.
...pain ...radi- ...in on ...a	Much anti-luetic treatment with salvarsan	March 23, 1922. Division of trunk and superior cardiac nerve just below the superior cervical ganglion	Gas and oxygen	1 month	Improved?	188/132	205/145	Pain was less after operation, but continued to annoy him so much that he went to a faith healer. Blood-pressure rose.
...after	Second admission Nov., 1923.	Mar., 1924. Removal of left ... nerve	Local	1 month	Relieved of			Patient developed a difficulty in ... occurred after operation.

1st adm.	P. K.								stenosis and insufficiency. Aortic insufficiency. Wide aortic arch. Beginning aneurism	recently, and severe radiating attacks of pain on the slightest exertion
11	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34,							Auricular fibrillation	Attacks recurred 20 mo. after
13	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med. 1923, V. 31, pp. 200–201	White	24	Male	8 days	Wassermann negative	Decompensated, auricular fibrillation. Orthopnœa. Œdema of legs	Only 2 severe attacks; first lasting 21 hours; 2nd 8 hours. Some minor pains in arm and neck
14 1st adm.	Coffey, W. B., and Brown, P. K.	Archiv. Int. Med., 1923, Vol. 31, pp. 200–201	White	54	Male	8 years	Wassermann positive	Enlarged. Mitral stenosis and insufficiency. Aortic insufficiency. Wide aortic arch. Beginning aneurism	Constant substernal pain recently, and severe radiating attacks of pain on the slightest exertion
14 2d adm.	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417						Auricular fibrillation	Attacks recurred 20 mo. after previous operation coincident with removal to higher altitude
15	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	44	Male	1 year	Wassermann positive	Enlarged. Double murmur. Wide arch	Pain mainly on exertion. Rather typical angina
16	Brown, P. K...	J. Am. M. Assn., 1923, Vol. 80, p. 1692	White	?	Male	3½ months	Wassermann negative	Much enlarged. Systolic murmur at the base. Wide aorta. Extra systoles	Rather typical attacks of angina; 8–10 minor attacks daily. Three very severe attacks suggesting coronary thrombosis had occurred
17	Borchard, A....	Archiv. f. Klin. Chir., Vol. 127, p. 212, 1923	White	54	Male	1 year	Not stated	Wide aorta. Somewhat enlarged heart. Sounds clear	Attacks every day for 4 months previous to operation. Very severe for past month and more frequent
18 19 20 21	Pleth, V.....	Am. J. Surg., 1922, Vol. 36, p. 300	Not		stated	Not stated	Not stated	Not stated	Not stated
22	Bacon, J. H....	J. Am. M. Assn., 1923, Vol. 81, p. 2112	White	78	Male	3 years	Arterio-sclerosis	Moderate enlargement. Wide aorta	Extreme pain. Rather typical anginal attacks. Numerous attacks daily
23	Halstead, A. E., and Christopher, F.	J. Am. M. Assn., 1924, Vol. 82, pp. 1661-1664	White	63	Female	3 years	No information	Myocarditis. Diastolic murmur at apex of heart. Size of heart not noted	Very severe lately and occurring while in bed and under treatment. 3 severe attacks during last 5 weeks
24	Kummel, B....	Zentralb. f. Chir., 1923, Vol. 50, p. 1434	White	60	Not	stated	Not stated	Not stated	
25	Reid, M. R....	J. Am. M. Assn., 1924, Vol. 83, p. 113	White	48	Male	4½ years	Wassermann positive. Mild arterio-sclerosis	Slight hypertrophy. Sounds clear	Typical angina. Minor attacks of pain daily and very severe attacks every seven to ten days
26	Reid, M. R.....	J. Am. M. Assn., 1924, Vol. 83, p. 113	White	54	Male	2½ months	Wassermann positive	Slight hypertrophy. Sounds clear	Pain was rather typical of coronary thrombosis. It was constant, but with frequent exacerbations. Marked precordial tightness
27	Reid, M. R....	Not previously reported	White	57	Female	7½ years	Wassermann negative	Aorta wide. Heart normal size. Systolic murmur at apex	Severe precordial pain radiating into fingers, unassociated with shortness of breath or a sense of impending death. Attacks almost daily
28	Reid, M. R....	Not previously reported	White	44	Female	1 year	Wassermann positive? Arterio-sclerosis	Moderate hypertrophy. Sounds clear	Severe attacks of angina, and almost constant pain in left arm and shoulder
29	Smith, F. J., and McClure, R. D.	Surg. Gyn. and Obstet., 1924, Vol. 39, p. 210	White	46	Male	1 year	Wassermann positive. Syphilitic aortitis	Aortic insufficiency. Moderate cardiac hypertrophy	Frequent attacks both day and night. Incapacitated for work
30	Smith, F. J., and McClure, R. D.	Surg. Gyn. and Obstet., 1924, Vol. 39, p. 210	White	69	Male	10–12 years	Wassermann negative. Arterio-sclerosis	Wide aorta. Chronic myocarditis. Coronary sclerosis. Dyspnœa. Slight cardiac hypertrophy	Severe attacks of pain both day and night
31	Kappis, M.....	Med. Klinik, 1923, Vol. 19, p. 1658	White	62	Female	3 years	Wassermann negative	Normal size. Normal sounds	Attacks typical of angina; brought on especially by effort
	and McClure, R. D.	1924, Vol. 39, p. 210					positive. Syphilitic aortitis	Moderate cardiac hypertrophy	and night. Incapacitated for work

		cardiac nerve just below the superior cervical ganglion	oxygen					continued to annoy him so much that he went to a faith healer. Blood-pressure rose.
after	Second admission Nov., 1923.	Mar., 1924. Removal of left nerve	Local	1 month	Relieved of			Patient developed a difficulty in occurred after operation.
ks; first and 8 pains in	Rest, digitalis, etc.	Feb. 1922. Division of the main trunk below superior cervical ganglion,	Procain	12 days	No pain	130/90	110/70	During operation it was noted that sponging of superior cervical ganglion caused pain in the supra-orbital region.
l pain re radi- pain on ion	Much anti-luetic treatment with salvarsan	March 23, 1922. Division of trunk and superior cardiac nerve just below the superior cervical ganglion	Gas and oxygen	1 month	Improved?	188/132	205/145	Pain was less after operation, but continued to annoy him so much that he went to a faith healer. Blood-pressure rose.
no. after n coin- oval to	Second admission Nov., 1923. Long period of rest and medical treatment during which attacks continued	Mar., 1924. Removal of left superior cervical ganglion	Local	1 month	Relieved of pain			Patient developed a difficulty in swallowing and a cough following this operation. These symptoms lasted for a few days. Fibrillation continued at times.
xertion. na	Iodides and mercury. Neo-salvarsan	April 6, 1922. Section of trunk and superior cardiac nerve just below superior cervical ganglion	Gas, oxygen and ether	6 hours	Death	130/60		No pain after operation, but a distinct vaso-motor disturbance like shock, ending in death six hours later.
ks of an- attacks severe coronary urred	Rest, digitalis and nitrites for 3 to 4 weeks	January, 1923. Excision *right* superior cervical ganglion	Gas, oxygen and ether	1½ months	No pain. Death from pneumonia and coronary sclerosis	160/98	140/80	Pain was largely dextral in radiation. No pain after operation, but patient was watched very carefully by his daughter and not allowed to exert himself.
for 4 operation for past equent	Iodides	May 3, 1923. Removal of the superior and middle cervical ganglia with intervening cord	Local	19 days	Pain relieved. Death from cerebral hemorrhage	190/135	Not stated	Pain in breast and left arm occurred at the time of section of the sympathetic nerve. Slight attack five days after operation but no others; cerebral hemorrhage occurred on the sixteenth day.
	Not stated	Did the "Jonnesco operation." No details are given	Probably ether	Not stated	3 well 1 dead	Not	stated	Cases are very briefly and unconclusively reported. No data are given except that one case died of aspiration pneumonia. Says the others were completely relieved.
er typi- . Num-	Rest, iodides, bromides, amyl-nitrite, nitro-glycerine, etc. No improvement	June 14, 1923. Excision of superior cervical ganglion	Procain	5 months	Well	140/80	120/75	In spite of the most heroic treatment the pain could not be relieved and kept away. Very striking and unmistakable relief after operation. Heart became smaller and sounds clearer.
and oc- ped and 3 severe 5 weeks	No information	March 19, 1924. Removal of middle cervical ganglion	Not stated	51 days	Well	198/120	178/100	
		Thorough extirpation of cervical sympathetic chain, with its three ganglia	Not stated	Not stated	No attacks	Not	stated	
inor at- and very ry seven	Anti-luetic treatment	June 7, 1923. Excision of the left sympathetic chain including the superior, middle and inferior cervical and first thoracic ganglia	Ether	16 months	Well	122/58	142/75	There have been no attacks of pain since the operation. The patient is a retired soldier, but has resumed light work since the operation. Interesting sensory disturbances developed in the left arm, chest wall and face following the operation (Vide. J. Am. M. Assn., July 12, 1924, Vol. 83, p. 114).
pical of sis. It ut with rbations. l tight-	Anti-luetic treatment	Dec. 29, 1923. A left cervical sympathectomy including the superior, middle and inferior ganglia	Ether	2 weeks	Pain completely relieved. Sudden death	140/90	130/80	On account of the patient's thick neck, I could not expose and remove the stellate ganglion without resecting the clavicle. The complete relief from pain was most striking. Death was also painless.
ain rad- s, unas- tness of impend- s almost	Rest. Nitroglycerine, potassium iodide	March 24, 1924. Excision of the left cervical chain including superior, middle and part of the inferior ganglia	Ether	6 months	Slight improvement	150/80	150/80	This case was regarded by several doctors as pseudo-angina rather than genuine angina.
gina, and in in left	Rest and iodides	July 28, 1924. Excision of entire cervical chain and stellate ganglion on the left side	Ether	3 months	Precordial angina relieved. Constant pain in arm persists	128/90		Patient has very severe pain in the left temporo-mandibular joint especially on eating. This began to be noticeable about two weeks after operation and is getting more severe. Sensory disturbances are becoming evident in arm and chest, and entire left side.
oth day acitated	Rest and vigorous anti-luetic treatment	Nov. 13, 1923. Removal of the left middle cervical ganglion and trunk up to the superior cervical ganglion. Jan. 18, 1924. Excision of the right middle and lower cervical ganglia	Local, gas and oxygen ether	5 months and 3 months	Improved	118/35	Not stated	Although he continued to have minor attacks of angina, the patient was so greatly relieved that he was able to rest at night and to resume work in daytime.
ain both		Nov. 20, 1923. Resection of the sympathetic cord below the superior cervical ganglion, including the middle and inferior ganglia	Local	4 months	Improved?	135/75	120/70	It is difficult to say if this case was relieved by the operation or by the development of a myocardial insufficiency.
angina; ially by	Rest and medicines	1923. Entire cervical sympathetic chain and stellate ganglion	Not stated	4 months +	Improved for 4 months, then a recurrence of pain	170/200	Not stated	Began to have pain in back and beneath sternum four months after operation. This pain gradually became worse.
acks of citated		1923. Cervico-thoracic sym-		4 months	Well			The author's first patient was com-

	treatment	the left middle cervical ganglion and trunk up to the superior cervical ganglion. Jan. 18, 1924. Ex-	and oxygen ether	and 3 months			stated	attacks of angina, the patient was so greatly relieved that he was able to rest at night and to resume work

	and McClure, R. D.	1924, Vol. 39, p. 210					positive. Syphilitic aortitis	Moderate cardiac hypertrophy	and night. Incapacitated for work
30	Smith, F. J., and McClure, R. D.	Surg. Gyn. and Obstet., 1924, Vol. 39, p. 210	White	69	Male	10–12 years	Wassermann negative. Arteriosclerosis	Wide aorta. Chronic myocarditis. Coronary sclerosis. Dyspnœa. Slight cardiac hypertrophy	Severe attacks of pain both day and night
31	Kappis, M.....	Med. Klinik, 1923, Vol. 19, p. 1658	White	62	Female	3 years	Wassermann negative	Normal size. Normal sounds	Attacks typical of angina; brought on especially by effort
32 33 34	Diez, J.....	Revista de la Asoc. Med. Argentina, Buenos Aires, 1924, Vol. 37, pp. 1–54. Abst. A. M. A., 1924, Vol. 83, p. 879		43	Male	11 years		Not enlarged. Hypertrophy and valvular disease	Daily typical attacks of angina
35	Hofer, G.....	Wiener. klin. Wchnschr. No. 26, June 21, 1924, p. 1357	White	53	Male				
36	Hofer, G.....	Wiener. klin. Wchnschr. No. 26, June 21, 1924, p. 1357	White	43	Male		Syphilis coronary stenosis		
37	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	54	Male	Two years	Wassermann negative. Aortitis	Heart sounds clear. Cardiac hypertrophy. Dilated aorta	Bilateral, often 5 or 6 a day
38	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	68	Male			Cardiac decompensation. Auricular fibrillation	Four severe attacks and several milder ones. Dextral radiation
39	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34. Oct., 1924, p. 417	White	41	Male	2½ months	Aortitis. Wassermann negative	Heart slightly enlarged. Dilated aorta	Pain in both arms and neck and under the sternum
40	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	28	Male	17 days		Mitral stenosis	
41	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34. Oct., 1924, p. 417		58	Male	9-10 yrs.		Heart enlarged. Dilated aorta	Pain substernal and radiating into left arm. Lately a severe attack daily, typical of angina
42	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	59	Male	8 yrs.		Cardiac hypertrophy	Not typical of angina
43	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	59	Male	3-4 years	Wassermann negative	Marked cardiac hypertrophy and dilatation. Wide aorta	Rather typical of angina. Substernal pain radiating to left arm
44	Coffey, W. B., and Brown, P. K.	Arch. Int. Med., Vol. 34. Oct., 1924, p. 417	White	68	Male	4-5 years	Wassermann negative. Arteriosclerosis. Chronic aortitis	Aorta thickened. Heart normal size	Rather typical of angina
45	Waffamger reported by Coffey and Brown	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	63	Male	20 years	Wassermann negative. Arteriosclerosis	Sounds clear. Arrhythenia	Typical angina
46	Mortensen, M. A., reported by Coffey and Brown	Arch. Int. Med., Vol. 34. Oct., 1924, p. 417							30-40 attacks a day
47	Lambert, A., reported by Coffey and Brown	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417			Female	"2 years of status anginosus"			Apparently typical angina
48	Harvey, S. C., reported by Coffey and Brown	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	54	Female	"Several yrs."		Evidences of heart failure. Dyspnœa orthopnœa	Typical angina
49	Harvey, S. C., reported by Coffey and Brown	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	48	Male	4 years	Syphilis aortitis	Aortic insufficiency	Typical angina
50	Holmes and Shackleton reported by Coffey and Brown	Arch. Int. Med., Vol. 34, Oct., 1924, p. 417	White	53	Female	1 year			Typical angina

		1923. Cervico-thoracic sym-		4 months	Well			The author's first patient was completely relieved and he was able to
citated	treatment	the left middle cervical ganglion and trunk up to the superior cervical ganglion. Jan. 18, 1924. Excision of the right middle and lower cervical ganglia	and oxygen ether	and 3 months			stated	attacks of angina, the patient was so greatly relieved that he was able to rest at night and to resume work in daytime.
n both		Nov. 20, 1923. Resection of the sympathetic cord below the superior cervical ganglion, including the middle and inferior ganglia	Local	4 months	Improved?	135/75	120/70	It is difficult to say if this case was relieved by the operation or by the development of a myocardial insufficiency.
angina; lly by	Rest and medicines	1923. Entire cervical sympathetic chain and stellate ganglion	Not stated	4 months +	Improved for 4 months, then a recurrence of pain	170/200	Not stated	Began to have pain in back and beneath sternum four months after operation. This pain gradually became worse.
cks of		1923. Cervico-thoracic sympathectomy after Jonnescos technic for all three cases		4 months and more	Well			The author's first patient was completely relieved and he was able to walk eleven miles without attacks. All cases showed an intense hyperæsthesia of the skin disappearing about three months after operation. The third case had severe cardiac and valvular disease, and was not relieved by the operation.
		Sept., 1923. Resection of entire cervical chain and stellate ganglion on the right side		5½ months	No relief			Attacks of angina were the same as before operation.
		Removal of entire cervical chain and stellate ganglion on the right side		48 hours	Dead			Death occurred from acute œdema of the lungs 48 hours after operation.
a day	Rest. Digitalis	Oct. 11, 1922. Resection of the sympathetic trunk and superior cardiac nerve	Gas-oxygen ether	2½ hours	Dead	108/62		The patient regained consciousness. The death was attributed to arterio-sclerosis and myocardial disease.
nd sev- Dextral		Excision of right superior cervical ganglion			Complete relief			
nd neck um	Rest in bed	June 21, 1923. Excision of left superior cervical ganglion	Gas-oxygen ether	8½ months	Relieved	125/85	135/110	The patient developed a brachial neuritis and desquamative dermatitis after operation.
		May 22, 1923. Removal left superior cervical ganglion		1 month	Partial relief	120/50	106/60	The case report is not typical of angina pectoris.
radiat- Lately y, typi-	Nitroglycerine	Aug. 15, 1923. Excision of superior cardiac nerve and division of sympathetic trunk on left side		10 days	Death	148/100	118/74	Death from cardiac failure. There developed air hunger and œdema of the legs.
	Digitalis	Nov. 19, 1923. Removal of left superior cervical ganglion	Local	6 weeks	Not relieved	118/70	122/86	Patient developed pain in the left temporo-mandibular joint and behind left ear following operation.
angina. adiating		Dec., 1923. Removal of left superior cervical ganglion	Local	8 days	(?)	200/118		
gina		Jan. 23, 1924. Resection of sympathetic trunk and superior cardiac nerve, left	Local	4 months	Improved	178/116	129/88	Patient developed maxillary pain following operation. He also had several post-operative attacks of angina, though less severe than before.
		Resection of the left superior cervical ganglion. Jan. 11, 1923	Local	4 weeks	Only partial relief	205/88 160/60	200/98 124/90	Diabetes.
	Nitroglycerine	"Left cervical sympathectomy"		2 weeks	Dead			Morphin addict and death is attributed to this and not to angina.
ngina		Resection of left superior cervical ganglion. Fall of 1923			Entire relief of pain on exertion			Taking out the superior cervical ganglion made a very painful set of reflexes along the ear and side of the neck.
		Apr. 18, 1923. Avulsion of left superior cervical ganglion after sympathetic chain had been severed	Local	1 year	No relief			Had typical eye and pupillary changes after operation.
	Antisyphilitic treatment	Avulsion of left superior cervical ganglion after sympathetic chain had been severed	Local and gas-oxygen	At least several weeks	Complete relief	No	change	Pain in left ear and left side of face and neck 4 days P. O. Blood-pressure observations over 10 min. intervals during operation showed no change.
	Nitroglycerine and amyl nitrite	July 12, 1923. Resection of left superior cervical ganglion		6½ months	Complete relief	No	change	Burning sensation at base of brain after stimulation of sup. cerv. ganglion following section of cervical trunk and superior cardiac nerve.

TABLE II.

Cases of Depressor Nerve Resectio

Case	Author	Publication	Color	Age	Sex	Duration of disease	Aortitis. Arterio-sclerosis. Syphilis.	Condition of heart	Nature of attacks	Pre-op
1	Eppinger, H., and Hofer, G.	Die Therapie der gegenwart, 1923, Vol. 64, p. 169	White	52	Female	9 months			Pain in chest and cramp-like painful radiations in the shoulder and arm; coming on both spontaneously and upon effort	
2	Eppinger, H., and Hofer, G.	Die Therapie der gegenwart, 1923, Vol. 64, p. 169	White	67	Male	5 years			Precordial pain radiating into right shoulder and neck. Coming on daily for the 5 weeks previous to operation	
3	Eppinger, H., and Hofer, G.	Die Therapie der gegenwart, 1923, Vol. 64, p. 169	White	49	Male	2 years	Luetic aortitis	Aortic insufficiency	Two or three attacks daily of pain that caused him to cry out	
4	Eppinger, H., and Hofer, G.	Die Therapie der gegenwart, 1923, Vol. 64, p. 169	White	57	Female	10 months			Typical angina pain in breast radiating into arm and hand	
5	Eppinger, H., and Hofer, G.	Die Therapie der gegenwart, 1923, Vol. 64, p. 169	White	73	Male	4-5 weeks			Constant feeling of pressure in breast and typical anginal attacks	
6	Odermatt.....	Quoted by Kappis, M. Med. Klin., 1923, Vol. 19, p. 1660	White	65	Male	4 years	Syphilis	Coronary sclerosis	Pain in the left hand and arm 4 years. Sensation of pressure in abdomen 2 years. Typical angina 10 mos.	Salvarsa
7	Hofer, G.....	Wien, klin. Wchnschr., 1923, Vol. 36, p. 334	White	54	Male				Doubtful angina	
8	Hofer, G.....	Wien. Med. Wchnschr., No. 26, June 21, 1924, p. 1357	White	54	Male	1 year	Syphilis		Left-sided attacks of angina pectoris	
9	Hofer, G.....	Wien. Med. Wchnschr., No. 26, June 21, 1924, p. 1357	White	60	Male	2 years			Left-sided attacks of typical angina, often as many as 15 a day	
10	Hofer, G.....	Wien. Med. Wchnschr., No. 26, June 21, 1924, p. 1357	White	73	Male	2 years			Typical attacks of angina radiating to both arms	
11	Hofer, G.....	Wien. Med. Wchnschr., No. 26, June 21, 1924, p. 1357								
12	Hofer, G.....	Wien. Med. Wchnschr., No. 26, June 21, 1924, p. 1357								

BLE II.

Resection for Angina Pectoris.

Pre-operative treatment	Operation	Anæsthetic	Latest observation after operation	Result	Blood-pressure		Remarks.
					Pre-operative	Post-operative	
	Aug. 22, 1922. Section of left depressor nerve		8 months	Returned to work without "noteworthy" difficulty			
	Jan. 9, 1923. Section of depressor nerve ?		4 months	Free of pain			
	Feb. 26, 1923. Section of both depressor nerves		12 days	Died 12 days after operation from bronchopneumonia. Had no attacks of previous pain during this time			Seven days after operation there occurred a paralysis of the vocal cords; first left, then right; cords assuming the median position and necessitating a tracheotomy.
	Feb. 28, 1923. Section of left depressor nerve		2 months	No pain since operation			Operated on both sides but found no nerve that they could identify as the depressor on the right. Found a well developed depressor nerve on the left.
	April 4, 1923. Section of left depressor nerve		1 month	No pain since operation			In their later cases (how many he does not say) they have also divided the ramus descendens hypoglossi because Schumacher and others showed that in certain cases fibres from the vagus may run in this nerve for a distance on their path to the chest.
Salvarsan given	Section of left depressor nerve		14 days	Died 14 days after operation from cardiac insufficiency			Autopsy showed dilatation of heart with luetic aortitis and coronary sclerosis. Kappis here reports Borchard's case as one of combined extirpation of upper two cervical ganglia and section of the depressor nerve as well.
	Mar. 28, 1923. Section of both depressor nerves; 2 days apart; left side last		22 days				No statement of result.
	Oct., 1923. Resection of the left depressor nerve		5 months	Complete relief			Patient returned to work as a decorator.
	Resection of the left depressor nerve			Relieved			On exercising or when subjected to changes of temperature following operation he had typical attacks of angina but these were not more frequent than once a week.
	Resection of the left depressor nerve. Second operation. Attempt to resect the right depressor nerve			Complete relief on the left side			The operator was unable to find the depressor nerve on the right side; the pain on this side continued.
	Attempt to resect the left depressor nerve			No relief			The depressor nerve was not found. Attacks similar to those prior to operation returned on the 10th day.
	Attempt to resect the left depressor nerve			No relief			The depressor nerve was not found. The anginal attacks recurred on the 5th day.

on such indefinite facts. Out of all the discussion has come the conviction of a fairly large group of people that an operative effort to relieve certain types of angina is justifiable. The value of these operations must be proven by results, and it is yet in the future before either party to this academic discussion, will be able to claim victory.

In the accompanying table an attempt has been made to summarize the important points of those cases of angina pectoris that have received surgical treatment and have been reported in the literature, except for two unpublished cases (Reid) that are included.

For the 62 collected cases various types of operations have been performed: (1) Excision of the lower cervical and first thoracic ganglia and intervening cord, 1; (2) excision of the entire cervical chain and the stellate ganglion, 15; (3) division of the cervical sympathetic cord and the superior cervical cardiac nerve, 8; (4) excision of the superior cervical ganglion, 13; (5) excision of the middle cervical ganglion, 2; (6) removal of the superior and middle cervical ganglia and intervening cord, 1; (7) excision of the middle and inferior cervical ganglia and intervening cord, 1; (8) excision of all cervical ganglia and sympathetic cord, 3; (9) resection of the depressor nerve, 10; (10) resection of dorsal root second thoracic spinal nerve, 1; (11) indefinite procedures, 8. In seven cases the operation has been performed on both sides of the neck.

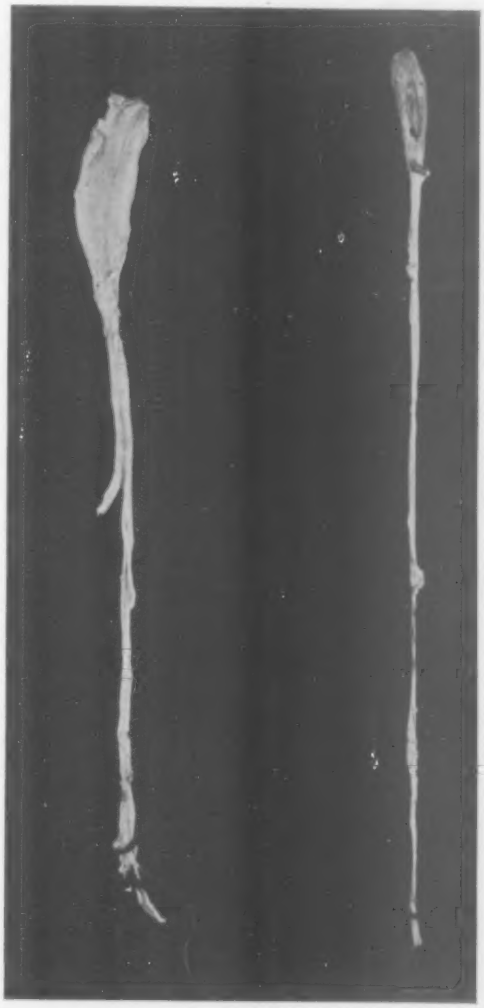

FIG. 2.—Cases 26 and 27. Left cervical sympathectomies. The patients were fat and short necked; the stellate ganglion could not easily be removed. These dissections were not as complete as they should have been.

In the actual performance of these operations most surgeons speak of using the procedure described by Jonnesco. The description and illustrations of this method are so accessible, particularly in Jonnesco's Monograph and Binney's Text-book of Surgery, that they need not be repeated in this paper. A dorsal approach to the stellate ganglion has been employed on cadavers by Henry, of Dublin, Ireland.

So far as we can learn, it has never been used in the surgical treatment of angina pectoris, though it has been used in the ligation of the first portion of the left subclavian artery. The approach through an incision anterior to the sternomastoid muscle and mesial to the neurovascular bundle, as indicated by Halstead and Christopher, would appear to be more difficult than the posterior approach as described by Jonnesco, especially if one desired to remove a long portion of the sympathetic chain.

In the fifty cases in which operations on the sympathetic nervous system were performed, ten deaths occurred within the first month, one after six weeks and another after eight months. Three deaths apparently occurred as a result of shock. In the twelve cases in which operations on the depressor

TABLE III

A Table of All the Cases Showing the Lapse of Time Between Operation and the Last Observation Prior to Publication

1. 7 years. 2. 18 months. 3. 18 months. 4. 3 days. (Death eight months after operation.) 5. 4 hours. (Death four hours after operation.) 6. 15 days. (Death four days after second operation.) 7. 2 days. 8. 1 month. 9. 8 months. 10. Not stated. 11. 1 month and 4 days. 12. 5 months. 13. 12 days. 14. 1 month. 15. 6 hours. (Death in shock.) 16. 1½ months. (Death from pneumonia and coronary sclerosis.) 17. 19 days. (Death from cerebral hemorrhage.) 18. Not stated. 19. Not stated. 20. Not stated. 21. Not stated. (Death from aspiration pneumonia.) 22. 5 months 23. 1¾ months. 24. Not stated. 25. 16 months. 26. 2 weeks. (Sudden and painless death two weeks after operation.) 27. 6 months. 28. 3 months. 29. 5 and 3 months. 30. 4 months. 31. 4 months +. 32. 3 months +. 33. 3 months +. 34. 3 months +. 35. 5½ months. 36. 48 hours. 37. 2½ hours. 38. Not stated. 39. 8½ months. 40. 1 month. 41. 10 days. 42. 6 weeks. 43. 8 days. 44. 4 months. 45. 4 weeks. 46. 2 weeks. 47. Not stated. 48. 1 year. 49. Not stated. 50. 6½ months.

Depressor Nerve Cases

51. 8 months. 52. 4 months. 53. 12 days. (Death from tracheotomy and bronchopneumonia.) 54. 2 months. 55. 1 month. 56. 14 days. (Death from dilatation of heart and coronary sclerosis.) 57. 22 days. 58. 5 months. 59. Not stated. 60. Not stated. 61. Not stated. 62. Not stated.

nerve were performed, there occurred two deaths; twelve and fourteen days after operation.

From the standpoint of beneficial effects our data are unsatisfactory, for so many of the cases have been reported so soon after the operation that it is unfair to place any value on the reported results of the operations (Vide Table III). Of the sympathectomies thirteen cases have been selected and charted that have shown the most striking improvement (Vide Table IV). Of the others the results have either been not satisfactory or the cases have been reported so early that they cannot be considered. Similarly, only three cases of depressor nerve resection appear to be highly satisfactory, and of definitely proven value.

The operation on the sympathetic system that has been most successful has been a removal of the stellate ganglion and all or a major part of the

cervical chain. Judging from the anatomy this result is what might have been expected. Bacon, however, had a very gratifying result after a removal of the superior cervical ganglion, and Coffey and Brown, a good result from simply sectioning the cervical sympathetic trunk and the superior cervical cardiac nerve.

Another striking fact is that the best results have been among those cases

TABLE IV

A Chart of the Cases Most Strikingly Benefited by Operation

Author	Operative procedure	Length of period of recorded observation after operation
Jonnesco	Two lower cervical and stellate ganglia. (Bilateral.)	7 years.
Jonnesco	Entire cervical chain and stellate ganglion.	18 months.
Jonnesco	Entire cervical chain and stellate ganglia. (Bilateral.)	18 months.
Bruning	Two lower cervical and stellate ganglia, and division of the superior cardiac nerve.	8 months.
Coffey and Brown	Section of sympathetic trunk and superior cardiac nerve just below the superior cervical ganglion.	5 months.
Coffee and Brown	Resection of the superior cervical ganglion.	8½ months.
Bacon	Excision of the superior cervical ganglion.	5 months.
Reid	Entire cervical chain and stellate ganglion.	17 months.
Reid	Entire cervical chain and stellate ganglion.	4 months.
Smith and McClure	Bilateral cervical sympathectomy.	5 and 3 months.
Diez, J.	Cervico-thoracic sympathectomy.	3 months +.
Eppinger and Hofer	Section of depressor nerve on the left side.	8 months.
Eppinger and Hofer	Section of depressor nerve.	4 months.
Eppinger and Hofer	Section of the left depressor nerve.	5 months.
Lambert, A.	Resection of the left superior cervical ganglion.	Several months.
Holmes and Shackleton	Resection of the left superior cervical ganglion.	6½ months.

of typical angina not associated with recognizable severe organic lesions or myocardial insufficiency. In Table IV, the only exception to this observation is the case of Coffey and Brown, in which there was an extensive organic disease of the heart. The other cases showed only a moderate cardiac hypertrophy.

Some authors have recorded a drop in blood-pressure following a sympathectomy, but of the collected cases such an observation has not been uniform nor striking. In a few instances the pressure has risen, and the drops in

pressure have not been strikingly more than could be accounted for by the rest and treatment incident to convalescence.

In the Journal of the American Medical Association for July 12, 1924, one of us reported some very unusual sensory changes following a cervicothoracic sympathectomy. Similar observations have been confirmed on two other cases. In one case, now six months since operation, there is a marked diminution in sensation of the left arm, chest and face. On the chest this was so great that the patient burned her skin with a hot water bottle without knowing it. She, however, did not have the pain resembling a trifacial neuralgia. In the other case, now three months after operation, there is developing pain in the face almost identical with the case reported. In addition the diminution in sensation of the left arm and chest and face is becoming evident. The anginal pain is completely relieved.

Depressor Nerve.—The division of the depressor nerve for angina pectoris seems to us to be open to these objections: (1) The proof of the function of this nerve rests upon physiological tests which have not been applied to human beings. This nerve in the rabbit is a separate nerve arising high in the neck from the superior laryngeal nerve and the trunk of the vagus, but in the dog and cat it runs within the trunk of the vagus. Bayliss believed that the depressor nerve in man coursed within the vagus; Bruning suggests that it runs with the sympathetic nerves; Wenckebach also points out that there are some recent articles which throw vagal and sympathetic fibres of the neck into one common system and even deny the existence of a depressor nerve. It is therefore not proven that what in man is considered by many as the depressor nerve is really the depressor nerve. It is identified, so far as we can learn, purely on anatomical grounds and its description corresponds pretty well to that of the depressor nerve in the rabbit. (2) It is almost impossible during operations to be sure that one has found this particular nerve that is anatomically supposed to be the depressor nerve. If it does rise high in the neck from the superior laryngeal nerve and then join, as in the rabbit, the superior cervical cardiac branch of the sympathetic, the surest way of sectioning it would be to remove the superior cervical ganglion and a portion of the superior cervical cardiac nerve until one arrived at its junction with the depressor nerve.

Cardiac Neuralgia.—There are two ideas about angina pectoris that we should like to discuss briefly. It is well recognized that there is a type of angina pectoris which bears little or no relation to recognizable cardiac pathological changes. In this particular type the cardiac nervous mechanism is especially under suspicion. It is in dealing with such cases that surgery has yielded the most striking results. The question naturally arises if there might not occur cardiac neuralgias similar to the trifacial neuralgias. In this connection it is interesting to note that Bruning has reported definite pathological changes in the sympathetic ganglia of a case that he relieved by operation. He noted: an increase in connective tissue, thick-walled vessels, perivascular and intercellular lymphocytic infiltration, ganglion cells very

large and apparently involved in a progressive degeneration, and areas suggesting neuronophagia. Bearing on this same line of thought is the very interesting report made by Danielopolu and Hristide before the Clinical Society of Bucharest. They were able to relieve a patient, who suffered from frequent and severe attacks of angina, by injecting novocain into the first and second posterior roots of the dorsal spinal nerves. They repeated this experiment several times and each time the angina was completely gone for a period of five or six hours even though during this time the patient was put through strenuous exercises. Without the procain the attacks came very often and were always provoked by the slightest exercise. These results were so striking that they attempted to resect these two dorsal roots. On account of the patient's fainting only the second root was divided, but this gave great relief from the pain. If there be such cases of neuralgic angina pectoris, operations for it become as logical as are operations for trigeminal neuralgia. It cannot be argued that such cases should not be liable to sudden death which, in the case of all angina, is probably of a reflex nature.

FIG. 3.—Left sympathectomy, including the entire cervical chain and stellate ganglion. The depressor nerve was probably not sectioned.

Spasm of the Cardiac Muscle.—The other idea of angina is that its basic process is of a similar nature to that causing intermittent claudication in the legs, *i.e.*, that it is due to localized cramps within the cardiac musculature. Mackenzie speaks of this possibility, and Bruning and Kohler believe such a process to be responsible for the sudden death and pain in angina pectoris. The acute bursting pain and vice-like gripping sensation could easily find an explanation in the occurrence of a muscular cramp. On the other hand, it is hard to understand how such a pain could be caused by a simple inflammatory process or by oscillations of the blood-pressure. Too, a prolonged cramp could explain the serious damage that many hearts manifest after a severe attack of angina. The heart muscle works constantly and it would not be surprising to learn that it is subject to frequent cramps, especially when it is overtaxed and poorly nourished. This is in accord with Danielopolu, who stresses the importance of what he calls a disturbance of the balance between the work of the myocardium and its blood supply. It is conceivable

that such cramps of the heart, if they occur, could be avoided by sectioning either the sensory or motor nerves, or both. At any rate, good results have been reported from all three procedures.

Any subject such as angina pectoris, about which there is so little definite knowledge, always invites speculation, and that is the excuse offered for the views set forth in the preceding two paragraphs. It is obvious that we are unwilling to accept Mackenzie's view that all angina pectoris is an expression of an exhausted muscle, and it is equally obvious that we are more unwilling to accept Albutt's contention that the pain of angina pectoris always arises from the aorta.

Finally, the term angina pectoris is unfortunate, for it has been, and must remain, a source of confusion, unless its meaning can be limited to a definitely recognizable affection. Nobody believes that all pain originating in and around the heart is always due to the same cause. Yet, in this country particularly, angina pectoris is used to denote any pain originating about the heart. Think how confusing it would be if all pain arising from or in the region of the gastro-intestinal tract was accepted as "dolar abdominalis" with the same degree of finality with which we accept "angina pectoris." We do not use "dolor extrematitis" for all pain arising in the extremities, whether it be due to boils, osteomyelitis, nerve lesions or what not. Perhaps, a more striking example of what is meant would be in connection with the distribution of the fifth cranial nerve. Here trigeminal neuralgia used in the sense of angina pectoris would include toothache, osteomyelitis of the jaw and a multitude of other specific causes of pain in the field of distribution of this nerve. But trigeminal neuralgia has come to be used to denote a definite clinical picture. It would be fortunate indeed if we could in some such way limit the meaning of the term angina pectoris. As it is now used, we conceive it to be a great hindrance to the development of an understanding of the causes of pain arising in the region of the heart. A definite meaning to the term angina pectoris will come (for the term is here to stay) just as there came to be a definite meaning to trigeminal neuralgia. In the case of the heart, however, the problem is much more difficult. Yet we feel very strongly that we already know enough to justify an attempt in this direction. If we do, much will be accomplished to prevent the disrepute that is coming to the surgical treatment of angina; and, in turn, the surgeons may contribute to the solution of at least one type of pain originating or centring in the distribution of the cardiac sensory nerves. Indeed, the more we study angina pectoris the more we are inclined to believe that its causes are just as varied as are the causes of pain in any other region of the body, and that it is just as illogical to treat all angina by the same therapeutic procedure as it is to treat all pain in any other region by the same procedure.

For the present it would seem to be advisable to limit our operative endeavors to those cases of typical angina unassociated with recognizable serious cardiac changes (the Heberden angina or the angina pectoris in the restricted British sense). Let us prove the merit of the operation in this type

where we have been rewarded by some brilliant results, and not run the risk of bringing it into general disrepute by subjecting it to a multiplicity of trials all at the same time. It is hardly to be expected that any single remedy could be successful in the care of all pains in and about the heart resulting from a multiplicity of causes. Where angina has been associated with marked recognizable cardiac lesions either valvular, vascular or myocardial, the results have generally been disappointing.

In view of the fact that the cardiac sensations are conducted both by parasympathetic and sympathetic nerves and that good results have been reported by operating on either path of conduction, we make the suggestion that in our operative procedure we attempt to interrupt both the depressor and sympathetic nerves. As the most desirable operation on the sympathetic system appears to be a cervico-thoracic sympathectomy, the additional removal of the smaller filaments mesial to the sympathetic trunk in the cervical region would entail no added risk to the operative procedure and would at the same time be the surest way of sectioning the supposed depressor nerve. Borchard followed such a procedure in his case and it seems to me a very logical standard procedure to adopt to prove the value of operating for angina pectoris. It is very likely that in Case 25, Reid resected the depressor nerve, without realizing it, for he removed numerous filaments mesial to the sympathetic trunk (Fig. 1).

The opportunity in these cases of learning more about the function of the sympathetic nervous system is exceptional and should be utilized. For most of us it would probably be wise to collaborate with a physiologist in making our observations and study. One of the best studies of this nature is reported by Kohler and Von der Weth, who utilized the case operated upon by Bruning.

SUMMARY AND CONCLUSIONS

1. In this paper there are collected from the literature sixty-two cases that have been operated upon for angina pectoris; in fifty cases the sympathetic nervous system was operated upon; in ten the depressor nerve of the parasympathetic system. In possibly two instances, Borchard's case and that of Reid, both depressor and sympathetic nerves were removed.

2. So many of the cases are reported so soon after operation that it is difficult to draw any definite conclusions as to results. Some thirteen patients, however, seem to have been unquestionably relieved of pain by the operative procedure.

3. Numerous operative procedures have been employed; the best results have been obtained by doing a cervico-thoracic sympathectomy.

4. The best results have been obtained in those cases of typical angina pectoris unassociated with recognizable serious cardiac lesions.

5. The causes of angina pectoris, in the American sense, are undoubtedly numerous. Two types, one resembling cardiac neuralgia and the other a process in the heart muscle similar to that producing intermittent claudication

elsewhere, are especially interesting from the standpoint of being benefited by operating upon the autonomic nervous system.

6. The term angina pectoris should be limited to a certain definite type of cardiac pain. As it is now used it is confusing.

7. The course of the depressor nerve in man has not been definitely proven.

8. It is suggested that in operations for angina pectoris it would be well not only to remove the cervico-thoracic sympathetic chain, but also the supposed depressor nerve.

9. Widespread sensory and motor disturbances have resulted from cervico-thoracic sympathectomy. In view of this every case should be most carefully observed following operation. It is the first opportunity we have had of studying such procedures upon coöperative animals. The operation presents an unusual chance to learn more about the function of the vegetative nervous system.

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SWELLINGS OF THE SUBMAXILLARY REGION*

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Immediately beneath the lower border of the mandible lies a region peculiarly related to the structures of the mouth in that it is frequently the seat of secondary manifestations of disease arising within the mouth and lower jaw. The boundaries of the submaxillary triangle are: Above, the lower border of the mandible and a line drawn from the angle of the mandible to the tip of the mastoid process; below, the anterior and posterior bellies of the digastric muscle. The coverings of the triangle are: The skin and the superficial cervical fascia, the platysma myoides and the deep cervical fascia. The superficial fascia and the platysma myoides form an inseparable layer attached above to the lower border of the mandible and blending imperceptibly into the superficial fascia and muscles of expression of the lower lip and chin. Beneath the platysma lie the submaxillary and submental lymph-nodes, which receive the lymphatics draining from the lower gums, floor of the mouth and tongue. Posterior to these and somewhat deeper, just beneath the angle of the jaw is the deep cervical node receiving drainage from the fauces and tonsil. Beneath the deep fascia is the submaxillary salivary gland. The floor of the submaxillary triangle is formed by the hyoglossus and mylohyoid muscles, the latter separating it from the mouth. The duct of Wharton leaves the under surface of the submaxillary gland, passes around the posterior edge of the mylohyoid muscle, then runs forward on the upper surface of this muscle beneath the mucous membrane of the floor of the mouth, and has its outlet in a papilla at the side of the frenum of the tongue. Other important structures lying within the submaxillary triangle are, the facial (external maxillary) and lingual arteries, the facial (anterior facial) vein, the branches of the facial nerve to the platysma and muscles of the lower lip, the hypoglossal and glossopharyngeal nerves. The facial artery is given off from the external carotid and passes upward and forward through the submaxillary gland to the facial notch which is a depression that can be felt in the border of the mandible about 2 cm. in front of the angle. Two branches of this artery, the submaxillary and submental, are given off in the submaxillary gland. The facial vein is also intimately connected with the submaxillary gland. The facial nerve branches to the platysma and muscles of the lower lip lie in the superficial fascia. The hypoglossal and glossopharyngeal nerves lie deeper and are not concerned in this paper.

There appears to be misapprehension about several conditions manifested by swelling in the submaxillary region. Sébileau called attention to this confusion in an admirable paper in the Presse Médicale, March 16, 1921. He

* Annual Oration before the Philadelphia Academy of Surgery, December 1, 1924.

points out the common error of regarding the acute inflammatory swelling in the submaxillary region following dental abscess as a lymphadenitis instead of a cellulitis by direct extension from the periosteum of the mandible. The course of an acute dental abscess beginning in the lower jaw depends entirely upon the place at which the pus perforates the bone. (The quotations following are from Sébileau's article.) "The abscess is at first intra-alveolar, then intraosseous; it then becomes subperiosteal, and finally extraperiosteal, provoking around it a more or less extensive cellulitis, which resembles lymphadenitis. If the perforation takes place at the level of the alveolar process of the jaw, there is formed a swelling in the vestibule of the mouth with a buccal opening or an opening on the skin of the face; if, on the contrary, the perforation occurs at the level of the body of the bone, a true submaxillary phlegmon is formed." The location of the swelling differs somewhat according to whether the outer plate, the inner plate, or the lower border of the mandible is perforated. That this process is one of osteoperiostitis and not lymphadenitis is shown by several facts: (1) The submaxillary swelling communicates with the alveolus. This can be demonstrated by pressure over the swelling causing pus to be discharged from the socket of the tooth. (2) If the submaxillary swelling is incised through the skin, with a probe a more or less extensive surface of denuded bone can always be felt. (3) All cases, and more especially those involving the posterior part of the mandible are accompanied by trismus or limited opening of the jaws. "The early onset and extent of the trismus bear a close relation to the nearness of the lesion to the wisdom tooth and the angle of the jaw. It would be an error to believe that trismus is entirely and constantly absent in lymphadenitis of the submaxillary and retroangular region, but here it is never so intense." The trismus is due to a fusion of the jaw bone with the inflammatory mass, and is the most important sign in diagnosis of osteoperiostitis. "Except for a few cases of diffuse osteomyelitis in children (and even this is open to discussion), mandibular osteomyelitis should practically always be regarded as of dental origin, either the consequence of dental caries, pericementitis, maleruption of the third molar, or retained teeth." Even those cases following fracture or other trauma are nearly always due to dental disturbances. Consequently, in every case manifesting an inflammatory swelling of the submaxillary region, accompanied by trismus, dental pathology should be suspected. Owing to the trismus, proper clinical examination of the inside of the mouth may be impossible, and much dependence must be placed on the X-ray. It is not denied that acute submaxillary lymphadenitis can exist, but very seldom as a complication of acute dento-alveolar infection. Lymphadenitis in this region is nearly always due to ulcerations of the oral soft tissues, the gums, vestibule and floor of the mouth and tongue. In tonsillitis and inflammations about the fauces the lymph-node beneath the angle of the jaw is involved. These lymphatic swellings are almost never accompanied by trismus. They are generally more circumscribed in the beginning than the osteoperiostitis cases. The submaxillary phlegmon complicating osteoperiostitis of dental origin usually

requires drainage by incision beneath the lower border of the jaw. By planning the incision according to the point at which the pus approaches the skin either in front of or behind the facial artery, annoying hemorrhage from cutting this artery will be avoided. The tooth or teeth from which the trouble originates should be removed at the time the external incision is made or soon after, otherwise a sinus may persist or the condition will recur, or the trismus may develop into ankylosis. Even though a considerable portion of the surface of the mandible be denuded of periosteum, prompt incision and drainage with removal of the cause may result in healing without necrosis.

A not uncommon condition is that of an acute or subacute swelling in the submaxillary region, fairly well circumscribed and quite tender to pressure. In the acute cases the pain may be severe. The patient will often state that this painful enlargement comes and goes every time he catches cold. There is no limitation in opening of the mouth. This condition also is usually diagnosed as an inflammatory enlargement of the submaxillary lymph-nodes, and attributed to drainage from infected teeth or tonsils. As mentioned above, it is quite the rule for a tonsillar infection to be accompanied by a lymph-node enlargement, the tonsillar node being situated rather at the angle of the mandible than in the submaxillary triangle itself. Acute inflammation of the gums and other soft tissues of the mouth, as in Vincent's gingivitis, are also characterized by lymph-node enlargement, this time in the submaxillary and submental region. But it has been shown that an entirely different picture characterizes the swelling from infection arising in the teeth and mandible itself. Here we have direct extension of the inflammation to the submaxillary soft tissues from a periostitis, with marked trismus. In the absence of an inflamed tonsil or acute stomatitis, what other conditions may cause the symptoms mentioned, *viz.*, acute or subacute circumscribed tender swelling in the submaxillary region? We must not overlook the presence in this region of the submaxillary salivary gland and the possibility of its enlargement from obstruction of Wharton's duct by a salivary calculus or by inflammation without calculus. It is this condition that is most commonly mistaken for a lymphadenitis due to infection from teeth or tonsils. In most of the cases that have come to our notice the patients have been told that the trouble was due to infection from the teeth, and have had one or more teeth extracted without relief. In typical acute inflammatory obstruction of the duct of Wharton by a calculus no difficulty should be encountered in diagnosis, yet even here the mistaken diagnosis of dental abscess is often made. The patient will generally give a history of several previous attacks, with increase of pain and swelling especially during meals (salivary colic). In addition to the tender circumscribed swelling in the submaxillary region, there will be painful œdematous swelling under the tongue and difficulty in swallowing. The outlet of the duct behind the incisor teeth may be reddened and pus may be expressed from it. An extremely tender nodule—the calculus—may be felt somewhere along the course of the duct in the floor of the mouth by combined intraoral and extraoral palpation. Occasionally, these symptoms and signs will exist from acute

inflammatory obstruction of the duct without calculus. The diagnosis is easy also when the stone is seen to be spontaneously extruded from the orifice of the duct. It is in the milder or subacute recurrent cases that there is more excuse for overlooking the true condition present. Here, the only symptoms may be more or less mild recurrent attacks of circumscribed tender swelling in the submaxillary region, with no particular complaint in the floor of the mouth. The likelihood of a stone should, however, always be thought of under these circumstances and careful palpation of the floor of the mouth will frequently reveal a point of tenderness or a hard nodule. The diagnosis will be confirmed by X-ray examination. A No. 2 film (2½ x 3¼ in.) is placed horizontally between the upper and lower teeth as far back in the mouth as possible with the sensitized side down, and the rays directed from beneath the chin. A calculus in the anterior three-fourths of Wharton's duct will cast a clear shadow on the lingual side of the teeth and jaw. If the stone is farther back, near the beginning of the duct, a lateral extraoral film may be required to show it. The extraoral method of examination for a small calculus in the anterior part of Wharton's duct is often unsatisfactory, as the stone shadow may be covered by that of the mandible.

The treatment of obstructive enlargement of the submaxillary gland by calculus in Wharton's duct is primarily removal of the calculus. If the calculus is in the anterior two-thirds of the duct this can be accomplished by an incision through the mucous membrane of the floor of the mouth under local anæsthesia. The cases vary greatly in difficulty. No doubt most of us have picked out with forceps a calculus impacted in the orifice of the duct. Where an incision becomes necessary, anæsthesia is best attained by injecting the lingual nerve as in the mandibular injection for extraction of teeth. A fine lacrymal probe passed into Wharton's duct often proves a valuable guide. The mucous membrane is incised in the direction of the duct, and in case of a large calculus the latter can then be readily felt with the finger, the duct incised and the stone liberated. In case of a small stone with little or no surrounding inflammatory reaction, the duct can be first isolated with the probe as a guide, and an incision made in it over the stone. In non-suppurative cases, the mucous membrane incision can be closed without drainage. If much acute inflammatory reaction or suppuration be present, a small wick of gauze or strip of rubber dam should be left in the incision. There is usually considerable reaction following the trauma of this operation, lasting for a few days, which may be partially controlled by hot mouth washes and the application of ice externally. Pain may call for a sedative. If the calculus lies near the point at which Wharton's duct is given off from the gland, removal by external incision is indicated. In cases of long standing, the gland undergoes degenerative changes from chronic inflammation, and even removal of the stone does not effect a return to normal. Here, it is advisable to remove the gland as well as the stone. In this operation, the usual skin incision runs about an inch below and parallel with the lower border of the mandible from just behind the symphysis to the angle. The platysma is divided along the same line and turned up as a separate

layer. In dissecting out the gland the facial artery and vein are divided and tied. In completing the operation the platysma and skin are sutured in separate layers. A small rubber dam drain is usually inserted for twenty-four to forty-eight hours. Very frequently some of the cervical branches of the facial nerve are cut during the operation, causing a characteristic inability to depress the corner of the mouth due to paralysis of the triangularis menti muscle. Improvement may occur with time. This accident is difficult to avoid, but there is less chance of its occurrence if the incision be made well below the border of the jaw.

Case I.—J. D., male, aged forty, reported that two years previously he began to have attacks of soreness in the floor of the mouth and difficulty in swallowing associated with inflammatory swelling in the right submaxillary region. The pain and swelling increased at meal times. The attacks occurred every two or three months, would be very severe for a few days and then gradually subside. On two occasions during attacks he had supposedly abscessed teeth in the right lower jaw extracted, without preventing recurrence. When seen on February 10, 1924, patient had been suffering from severe pain in the right submaxillary region and back part of the floor of the mouth, and had been unable to swallow anything but liquids for several days. There was a large, tender deep-seated swelling in the right submaxillary region about the size of a small hen's egg, surrounded by redness and œdema. The right side of the floor of the mouth was red, tender and swollen, the orifice of Wharton's duct being distinctly inflamed. No definite nodule could be felt in the floor of the mouth on bimanual palpation. There was practically no limitation of opening the mouth. An intraoral X-ray film showed no calculus in the anterior two-thirds of Wharton's duct. A lateral extraoral film, however, showed a large calculus between the posterior part of the lower border of the mandible and the hyoid bone. February 12, 1924, under ether, through an incision one inch and parallel to the right lower border of the mandible, the submaxillary gland and the calculus were removed. In order to get at the stone, which was embedded in a dilatation of Wharton's duct beneath the gland, it was necessary to dissect the latter entirely free. The wound was closed in two layers, interrupted catgut for the platysma and fascia and dermal suture for the skin. A small rubber dam drain was left in place for forty-eight hours. There was considerable purulent discharge for four or five days, but the patient recovered completely in two weeks. Pathological examination revealed chronic inflammatory changes in the gland.

Cases of chronic inflammatory enlargement of the submaxillary gland with recurrent acute attacks are also met with in the absence of calculus. These are due to obstructive inflammation of the duct, and give rise to the same symptoms as those of obstruction due to calculus. If persistent these also demand excision of the gland. Case II is an example of this condition:

Case II.—P. R., physician, aged fifty, presented a rather interesting history of obstruction of several ducts. Eight years ago he was operated upon for obstruction of the bile duct, and two days later for an abscess of the right parotid gland. About two years ago, while eating, he first noticed a soft swelling in the right submaxillary region, which disappeared after a few days. Since that time he has had many attacks, varying in severity, of painful swelling in the right submaxillary region, with inflammation beneath the tongue and difficulty in swallowing. When first seen early in September, 1924, there was a hard, tender swelling about the size of a walnut in the right submaxillary region. The floor of the mouth on the right side was red, tender and somewhat swollen. No nodule could be felt, and a lacrymal probe could be passed well back in Wharton's duct without encountering a stone. Intraoral and extraoral X-ray films were negative for

calculus. Within the next few days improvement occurred, but then the symptoms suddenly grew worse. September 13, 1924, the right submaxillary gland was removed. After a few days of muco-purulent discharge the wound healed. There is slight paralysis of the right corner of the mouth, which is gradually becoming less apparent. Examination of the gland after operation failed to reveal any calculi but showed chronic inflammatory changes.

Other Conditions Causing Swelling in the Submaxillary Region.—Carcinoma beginning in the mucous membrane of the cheek, gums, floor of the mouth or tongue is usually accompanied in its late stages by metastatic deposits in the submaxillary lymph-nodes. The diagnosis of submaxillary enlargement from this source generally presents no difficulties because of the presence of the primary lesion within the mouth. Rarely, a carcinomatous involvement of the lymph-nodes in this region occurs in which it is difficult to locate the primary source of the disease. Recently a patient was seen with metastatic carcinoma of the submaxillary lymph-nodes, in whom the primary lesion was in the ethmoid cells. The ethmoid disease was not discovered until several months after appearance of the submaxillary swelling.

There are several other important conditions which give rise to swelling in the submaxillary region, most of them involving the lymph-nodes, which will not be taken up in detail here. Among these are syphilis, tuberculosis, certain forms of leukemia, dermoid cysts and ranula. In conclusion, I wish to emphasize the differentiation between the three most common acute inflammatory swellings appearing beneath the border of the mandible:

(a) Infection from the teeth and alveolar process causes a periostitis with extraperiosteal cellulitis and submaxillary phlegmon, not through lymphatic channels but by direct extension into the soft tissues from the periosteum. It is characterized by marked trismus, or limited opening of the mouth, particularly when the molar teeth are implicated.

(b) Infection from the gums, mucous membrane of the floor of the mouth, tongue or tonsillar region, causes submaxillary lymphadenitis, the swelling here being unaccompanied by trismus of any consequence.

(c) Obstruction of Wharton's duct by calculus or by inflammation without calculus may cause acute inflammatory enlargement of the submaxillary salivary gland. There is nearly always evidence of inflammation beneath the tongue, swelling and pain increased on eating. X-ray may show stone, or the latter may be palpated. Trismus is not a prominent feature.

THE RELATION OF THE SUBMAXILLARY SALIVARY GLAND TO INFECTIONS OF THE SUBMAXILLARY TRIANGLE OF THE NECK

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Glandular abscesses of the submaxillary triangle of the neck are not infrequent because these regional lymph-nodes drain a very extensive area, certain parts of which are continually exposed to infection. They occur most frequently in children, either in that period when teeth begin to erupt or at that age when decay begins, and even in adults, they usually follow some dental trouble. The largest percentage of these cases are so simple that they are treated in the Out-patient Department of hospitals. A certain number are admitted to the general surgical wards, where they rarely elicit much surgical enthusiasm, the majority subsiding uneventfully with simple incision and drainage. In the past ten years, one hundred and ten cases of submaxillary abscess were operated upon at Mt. Sinai Hospital, one hundred and six of these being discharged after an uneventful recovery. There were only four cases which caused any anxiety. These were in the group of acute, diffuse, infectious phlegmons of the floor of the mouth called by many "Ludwig's angina." The angina Ludovici is a misnomer, for it is not always an angina, and Ludwig was not the first to describe it. In 1830, Gensoul [1] of Lyons published the first communication bearing upon this disease, which one hundred years ago was apparently common, and in a simple terse way described its main clinical features. In 1836, Ludwig,[2] a professor at Stuttgart in Wurtemberg, spoke of it as a gangrenous phlegmon of the neck with a hardness of stone, and compared it to an erysipelas with nervous system complications. His report created quite a stir at the time, probably not so much because of its subject-matter, as the fact that Queen Catherine of Wurtemburg died of this malady. It was Camerer,[3] who in 1837, gave it the name of "Angina Ludovici," and from then on, innumerable reports and series of collected cases have filled the literature, and Ludwig's Angina has been made to include almost every infectious process in the region of the mouth, pharynx and neck, especially if it terminates fatally. There is probably no term in surgery which includes more but means less than this, and the sooner it is dropped from medical nomenclature, the better and clearer the diagnostic records will be.

It is not within the scope of this paper to discuss the pathology, symptomatology, diagnosis, complications or prognosis of acute, diffuse phlegmons of the floor of the mouth. A most excellent review of the literature with a summary of cases reported from 1836 to 1898 has been published by Cocar,[3]

and although his thesis appeared more than twenty-five years ago, very little new has been added since except some modifications in treatment.

It is now almost universally recognized that these phlegmons of the floor of the mouth are infections of the cellular tissues, the infective agents gaining entrance directly through the buccal mucous membrane, through Wharton's duct, or the ducts of Rivinus, from the afferent lymph-vessels or lymph-nodes of the submaxillary and submental regions, or from a periostitis, or osteomyelitis of the lower jaw. In a great many of the reported cases, sublingual swelling and elevation of the tongue occurred only after the submaxillary tumor had been noted.[4] (See Case III.) This may be explained by the fact that extension of the infection occurred secondarily into the cellular tissues of the floor of the mouth from a breaking down of the original focus. It is a mistake, however, to take for granted the primary involvement of the submaxillary salivary gland; this happens in no more than 50 per cent. of the cases and then, as a rule, only as a secondary complication.

The prognosis in these cases is usually regarded as grave, for the mortality is around 40 per cent. A mortality of this magnitude is a severe indictment against its surgical management. One of the fundamental reasons for this large morbidity is that the treatment by incision is either performed too late or is inadequate, or that the drainage which has been established is unsuccessful. The proper treatment of this serious, life-threatening condition must be based not alone upon its pathology, but upon a proper anatomical knowledge of the cellular tissues of the submaxillary triangle, especially from the standpoint of fascial spaces and muscle planes.

Exhaustive studies of the lymph drainage of the floor of the mouth have been made by many anatomists,[5, 6, 7, 8, 9] and although they vary in their finer details, the essential facts are practically the same. The submaxillary group of nodes receive the afferent lymphatic vessels of the bridge and alæ of the nose, the nose itself, the upper and lower lips, the cheeks, the chin, and the buccal cavity. The lymphatic vessels of the face form a diffuse network, especially dense at the chin and the alæ of the nose. These lymphatics arise mainly from the papillæ and pylosebaceous follicles of the skin, some from the muscles, and others from the perichondrium and periosteum. They form superficial and deep collecting trunks which are directed through the cellular tissues of the floor of the mouth to the lymph-glands of the neck. Some of these collecting vessels, especially from the nasal alæ, nostrils, commissures of the lips, and the under region of the chin may drain into the submental nodes first and then into the submaxillary group, while other vessels from the nose and cheeks drain into the deep cervical nodes. Occasionally, the lymph-vessels may drain into the glands of the opposite side. The lymphatics of the buccal cavity which are in continuity with the lymphatics of the skin at the angle of the mouth, as a rule, terminate in the submaxillary nodes. The lymphatic network of the lower gums is usually continuous with that of the buccal floor, and empties into the submaxillary ganglion. As far as the lymphatics of the teeth are concerned, their drainage is probably the same

as the gums. It is likely that the lymphatics of the incisor teeth empty into the submental group, the canine and pre-molars into the first group of submaxillary nodes and the remaining molar teeth into the second and third group. Part of the lymphatics of the tonsil and tongue, especially its base, terminate, too, in the submaxillary chain.

The submaxillary group of lymph-nodes which are extremely important vary in number from six to eight and form a chaplet along the inferior border of the mandible. They are placed subaponeurotically in the submaxillary triangle superficial to the submaxillary salivary gland, although occasionally very small nodes have been found deep to this organ. Most [5] divides these nodes into three groups, one gland in relationship to the submental vein, two glands which are larger and more constant are found where the facial artery crosses over the mandible, and the third group are found behind the facial artery and the anterior facial vein. To recapitulate, these nodes receive the drainage of the vessels from the nose, cheeks, buccal cavity, gums, tonsils and part of the tongue. The submental nodes which empty into the submaxillary are placed between the anterior bellies of the digastric and the hyoid bone. They receive the afferent vessels from the chin, the lower lip, part of the mucous membrane of the buccal cavity and possibly the tip of the tongue. It is now very evident why abscesses in the submaxillary triangle are so common and why a primary focus at some distance from the submaxillary region may be the possible source of infection. While most of these glandular abscesses, therefore, must be superficial to the submaxillary salivary gland, the cellular tissue of the floor of the mouth may still be involved directly, or what is more frequent, secondarily.

When once infection has been established in the loose areolar tissues, its rapid spread is guided by the various fascial spaces and planes. Poulson [10] in 1886 published the results of his anatomical studies of the planes of cervical fascia with special reference to the spread of lime which he injected in various areas of the triangles of the neck. And it is interesting to note that many years later the clinical data gathered from a series of 500 abscesses [11] of the neck ran almost parallel to his anatomical deductions as far as the spread of infection was concerned. It shall not be necessary here to enter into a discussion of the various planes of the deep cervical fascia which Morgagni has so aptly called the anatomical proteus. Only those entering into the formation of the submaxillary triangle shall be discussed.

This triangle of the neck is bounded above by the body of the mandible, anteriorly by the anterior belly of the digastric, posteriorly by the posterior belly of the same muscle, the inferior angle being limited by the hyoid bone. The mylohyoid muscle which extends from the internal oblique line of the mandible downward and inward to the hyoid bone forms a partial wall for this triangle and acts as the floor of the mouth. The triangle is covered by the superficial fascia and the superficial layer of the deep cervical fascia. The deep cervical fascia, if traced from the midline of the suprahyoid region begins as a single layer covering the forepart of the mylohyoid muscle and

at the external border of the anterior belly of the digastric it splits into two leaflets. The superficial which is quite strong, firm and rather dense, spans the space between the two bellies of the digastric, is attached above to the under surface of the jaw, and below to the hyoid. The deep leaflet which is thin and delicate blends with the perimysium of the remainder of the mylohyoid and part of the hyoglossus muscle, and is inserted finally into the inferior oblique line of the mandible above. Between these two fascial leaves which blend together in the region of the hyoid bone is the "submaxillary compartment," the main occupants of which are the submaxillary, salivary gland, and superficial to it the submaxillary lymph-glands. This space extends about 7 mm. beyond the central tendon of the digastric muscle at its indirect attachment to the hyoid bone.

The "submaxillary space" is in direct communication anteriorly with the "sublingual space" (see Fig. 1), the floor of which is formed by the mylohyoid muscle, the roof by the alveolar lingual mucous membrane, the mesial wall by the tongue, the lateral wall by the alveolus, the space harboring the sublingual gland, a deep process of the submaxillary salivary gland and Wharton's duct. Posteriorly it is separated from the retromaxillary space by a fascial septum. This retromaxillary space is quite important, being bounded anteriorly by the posterior margin of the ramus of the inferior maxilla, and the pterygoid process; posteriorly, by the mastoid process and the transverse processes of the atlas and axis, and superiorly, by the petrous portion of the temporal bone and the cartilaginous part of the external auditory meatus. The soft parts which upholster this region are anteriorly the superior constrictor of the pharynx, the internal pterygoid muscle, inferiorly the sternomastoid muscle and the posterior belly of the digastric which separates it from the superior carotid triangle. The space thus bounded may be divided into two apartments. In the upper there is the parotid gland, in the lower the paquetum Riolandi (made up of the stylohyoid, the styloglossus, the stylopharyngeus), the posterior belly of the digastric muscle, and blood-vessels and nerves.

The submaxillary and sublingual spaces are real, the retromandibular—potential; the submaxillary salivary gland bears an important surgical relationship to these spaces. This gland was found to vary very much in size and its anatomical position to these spaces, as was evidenced by dissections of the submaxillary triangle of twenty-five cadavers undertaken in the anatomical laboratory of the Dental Department of the College of Physicians and Surgeons. The organ itself is enclosed in a capsule of white fibrous connective tissue, adherent rather closely to the superficial layer of the deep cervical fascia, while the posterior surface of the salivary gland is bound but insecurely and loosely to the deep layer of the deep cervical fascia by a loose areolar tissue which may or may not contain fat. Most of the gland is situated in the submaxillary triangle reaching forward to the anterior belly of the digastric and backward to the stylohyoid ligament which lies between it and the parotid gland. It extends superiorly under the

cover of the body of the mandible and inferiorly it usually overlaps the central tendon of the digastric and the insertion of the stylohyoid muscle. From its deep surface, a tongue-like process may extend forward and inward above the mylohyoid muscle into the sublingual space. (Fig. 1.) The deep surface of the gland from before backward is in relationship to the mylohyoid, the hyoglossus, the superior constrictor of the pharynx, the styloglossus, the stylohyoid and the posterior belly of the digastric muscles. The facial artery is either in the substance of the gland or posterior to it, and comes into the interfascial space on the inner side of the digastric muscle. The posterior facial vein comes to the outer side of this muscle and lies imprisoned in the superficial cervical fascia. It is now apparent that the submaxillary salivary gland occupies not only the submaxillary space, but the sublingual and part of the retromandibular space. The surgical importance of this relationship cannot be overestimated, for those three spaces either separately or collectively may be involved in infections of the floor of the mouth and their proper drainage can only be secured by a proper anatomical approach.

Poulson injected the submaxillary interfascial space and a tumor was produced lying between the two bellies of the digastricus, limited above by the free border of the mandible and below by the hyoid bone. Within this space the injection substance occupied the loose areolar tissue, and spread between the lobules of the salivary gland. If more material were injected the mass protruded forward along the anterior belly of the digastricus and in front of the anterior surface of the sternomastoid, finally rupturing *via* the anterior facial vein along the internal jugular into the superior carotid triangle. As the mass sunk into this region it simultaneously proceeded into the alveolar lingual sulcus, along Wharton's duct and the sublingual gland, above the mylohyoid muscle, raising up the mucous membrane of the floor of the mouth. Some of the injection mass by rupturing the thin fascial leaflet covering the inferior surface of the mylohyoid muscles, passed through its parallel bundles of muscle fibres, thus gaining the alveolar lingual sulcus. Now that this thin, deep layer of the deep cervical fascia has been ruptured, the injection mass followed easily along the posterior belly of the digastric, getting between the paquetum Riolandi (stylohyoid, styloglossus, stylopharyngeus muscles and the stylohyoid and stylopharyngeal ligaments), thus forcing itself into the deep recesses of the retromandibular space, gaining the pharynx in the region of the tonsils. (Fig. 1.) From this discussion of the anatomy of the fascial spaces in relationship to the submaxillary salivary gland, it is quite evident that infections in this region may be divided into those either superficial or deep to the submaxillary salivary gland, *i.e.*, a lymphadenitis involving the submaxillary group just under the superficial layer of the deep cervical fascia superficial to the salivary organ or a cellulitis of the loose areolar tissue deep to the submaxillary salivary gland. The former class constitute the great majority of submaxillary triangle infections, the usual submaxillary abscesses. The latter class constitute the rarer, more serious,

acute, diffuse, infectious phlegmons of the floor of the mouth. This last-named group of infections may involve either the sublingual or the submaxillary or the retromandibular spaces. The origin of the surgical condition may be in either one of the three, the other two being involved by direct extension from the primary source of the cellulitis.

The differential diagnosis of the seat of these various infections is important because the proper surgical treatment depends upon it. Fortunately the differential diagnosis is comparatively simple. These infections superficial to the submaxillary salivary gland, aside from the fact that the overlying skin is reddened and hot and that fluctuation is present, are rarely complicated by swelling and actual œdema of the floor of the mouth. The mouth may be opened with comparative ease, the tongue is not elevated and may be protruded and moved from side to side without difficulty or pain. In Poulson's 251 cases of submaxillary abscesses less than 9 per cent. showed any elevation of the alveolar lingual sulcus and some of these were complicated by infections deep to the salivary gland. In this series of 110 cases, œdema of the mucous membrane of the mouth occurred in less than 5 per cent. Infections deep to the submaxillary salivary gland reveal an entirely different medical picture. The swelling in the submaxillary triangle is definite, but the skin, while œdematous, is not reddened. Fluctuation is obtained with difficulty and the mass feels stony hard. The mouth is opened with difficulty, the tongue, as a rule is raised, is fixed, and practically immobile. There is marked œdema and swelling of the floor of the mouth and on palpation the mucous membrane appears brawny and indurated. If the retromandibular space is involved, the face is congested and cyanotic from pressure on the great vessels. Deglutition is almost impossible because of the pressure on the lateral pharyngeal wall and dyspnœa is present because of the beginning œdema of the soft tissues about the glottis.

Abscesses in the submaxillary triangle usually arise in the lymph-nodes superficial to the submaxillary salivary gland. A simple, horizontal incision parallel to the inferior border of the mandible over the area of fluctuation carried down through the superficial layer of the deep cervical fascia opens the pus pocket. The infection usually subsides in a few days following drainage with a small rubber tube or rubber dam aided by wet dressings or in some cases, hot flaxseed poultices. This group constitutes by far the greatest proportion of all cases.

Infections deep to the submaxillary, salivary gland are the type of cases requiring very careful attention and keen surgical judgment. Here pus is unusual, the pathological process, as has been previously mentioned, resembling a diffuse cellulitis. These cases because of their rapidity of progression and the intensity of the infection, are usually acutely ill. As a rule, they are seen late in the disease, either after conservative measures have failed or surgical incisions improperly placed have been of little avail. If seen early, they respond readily and rapidly to the proper treatment. If the infection involves the sublingual space, it may be treated by one of two ways, but it must be

treated surgically, either by incisions through the mouth or incisions through the neck. At first thought, the buccal incision appears unsurgical; of course, it is made through the mouth through an infected field, but the organisms of the cellulitis, as a rule, are so virulent that secondary infection need not be feared. Provided the infection is in the sublingual space, incision in the

FIG. 1.—Posterior view of a frontal section cut obliquely through a frozen human head, demonstrating the sublingual and submaxillary spaces, and part of the retromandibular geniohyoid muscle. 2. Lingual artery. 3. Dorsum of tongue. 4. Submaxillary salivary gland. 5. Hyoglossus muscle. 6. Facial artery. 7. Mylohyoid muscle. 8. Posterior belly of digastric muscle. 9. Uvula. 10. Nasopharynx. 11. Ramus of mandible. 12. Superficial layer of deep cervical fascia. 13. Lingual artery. 14. Submaxillary salivary gland. 15. False dissection. 16. Facial vein. 17. Stylohyoid muscle and posterior belly of digastric muscle. 18. Tonsil. 19. External carotid artery. 20. Internal carotid artery. 21. Internal jugular vein.

alveolar lingual sulcus (Fig. 1) will probably give better drainage, even though uphill than one through the neck, but it is rather difficult to secure adequate exposure, and these incisions are really only applicable in these cases in which the infection has started in, and is confined alone to the alveolar lingual sulcus. This, as is well known, is rarely the case.

If the infection is to be treated by incising the neck, there are two ways of attacking the problem, one is by an anatomically proven incision, the other

by an empirical one. The empirical one is a median incision extending from the under surface of the chin to the hyoid bone. This is one employed quite commonly and may be partially accountable for the mortality of forty per cent. It simply divides through the median line the muscle planes of the floor of the mouth and the tongue, namely, the mylohyoid raphé, the geniohyoid and the geniohyoglossus, but the infection is only rarely in the muscles, it is usually in the areolar tissues of the submaxillary triangle. These cases showing gangrene of the muscles are the late cases, the ones in which the blood supply has become thrombosed and infection has entered the tongue terminally. Besides, these are not primarily cases of glossitis, they are either cellulitis of the floor of the mouth or direct infections of the submaxillary salivary gland. The median incision only offers indirect drainage.

The incision of choice is a lateral one originally advocated by DeLorme.[12] A study of Fig. 1 will convince one of its superiority, but in making the lateral incisions, several factors must be borne in mind. If the infection is in the alveolar lingual sulcus with most of the swelling in the submental region, a lateral incision parallel to the mandible must do more than divide the deep cervical fascia of the neck, it must divide the mylohyoid muscle at right angles to its fibres, from its free lateral border to the median raphé, cutting if necessary the anterior belly of the digastric muscle near its mandibular attachment. (See Case I.) This incision will afford not only free drainage of the space, but there is very little danger of doing injury to the ranine vessels, Wharton's duct or the sublingual glands. If the infection has already spread to the submaxillary space, there are two things which may be done. Either a curved horizontal incision is made similar to the one used for excision of the submaxillary salivary gland, and the tense bulging fascia is divided and drains placed deep to the submaxillary salivary gland running upward into the mandibular region, or what is better, the submaxillary salivary gland is extirpated. (See Case II and Case III.) At first thought, this procedure may be thought entirely too radical, too dangerous, and even unnecessary. These patients, as a rule, are extremely sick, toxic, dyspnœic and cyanotic. Any operation which is performed must not only give free drainage to these toxins, but must mechanically relieve pressure against the pharynx and indirectly the larynx. The submaxillary salivary gland with its closely adherent superficial leaflet of the deep cervical fascia is a dense, hard, unyielding barrier. This is borne out by the fact that in seventeen collected cases which ruptured spontaneously, sixteen ruptured internally. Simple division of the fascia still leaves the submaxillary gland blocking not only the drainage of the sublingual space, but the mandibular space and the retromandibular space. Phlegmons of the floor of the mouth have been known to perforate into the pharynx in the region of the tonsils simply because the infection was forced to burrow internally because of the unyielding nature of the submaxillary salivary gland; and since 50 per cent. of these cases may be complicated by the organ itself being the seat of infection, to cure the disease, the gland must be removed. The

tissues, to be sure, are œdematous, the anatomy of the region distorted and the patients, as a rule, such poor surgical risks that they will not stand much manipulation. The operation must be done under local anæsthesia. The gland capsule, after the fascia has been divided, is usually recognized, and by working bluntly from the hyoid part of the gland upward, carefully watching for the facial vein, which is superficial, and the facial artery, which may be deep or in the substance of the gland, its extirpation may be accomplished without very much trouble. Care should also be taken to avoid injury to the lingual artery and lingual vein which lie rather superficial, being covered only by a few fibres of the hyoglossus muscle. With the gland removed, drainage is certainly free and pressure is relieved from the pharynx and larynx. In some cases, should the dyspnœa either during operation or just after operation be at all menacing, a tracheotomy may be performed.

Since the education of the public upon the necessity of better dental hygiene, infections of the floor of the mouth are seen but rarely, but when they occur, they should be treated surgically and energetically, and where the infection has left the confines of the sublingual space and where a lateral incision with division of the mylohyoid would prove inadequate, no hesitancy should be used in removing the submaxillary salivary gland to promote freer drainage.

Case I.—*Alveolar lingual space infection.* No. 13017. J. L., female, thirty-four years old. United States. Admitted July 7, 1923 to the service of Dr. A. V. Moschcowitz.

History.—Four days before admission, a tooth was extracted in the anterior portion of the right mandible. Following this, the face and region under the chin became swollen and twelve hours before admission, two incisions were made below the jaw but no pus was obtained. After this the patient became much more ill, the tongue became swollen and the mouth could only be opened with difficulty. On admission, the patient was acutely ill, the tongue was elevated, the mouth opened partially with difficulty. There was marked œdema and wooden induration of the floor of the mouth and on either side of the median line just below the jaw were two incisions. The submental region was swollen, brawny and the overlying skin was œdematous.

Under local anæsthesia, Doctor Klingenstein connected the two incisions which he deepened and after cutting the fibres of the mylohyoid muscle, pus was evacuated, two definite abscess cavities being entered, one of which entered the buccal cavity. No bare bone was felt and the tube was placed down to the mucous membrane.

Following the operation, the œdema of the floor of the mouth rapidly subsided and the patient made an uneventful recovery.

Case II.—*Primary infection of the submaxillary, salivary gland with secondary extension into the floor of the mouth.* H. K., male. Physician, thirty-five, United States. Private patient of Doctor Moschcowitz.

Several times a year for a number of years, patient experienced a peculiar sensation in the region of the right sub-maxillary space followed by a moderately painful induration which interfered with mastication and an increased flow of saliva into the corresponding side of the mouth; this condition persisted for a number of hours, not exceeding twenty-four, then quickly subsided; each time the attack occurred the teeth were examined for a possible cause until the present attack cleared the diagnosis.

The attack in question came on in the usual manner with the exception that an uneasy sensation was experienced in the floor of the mouth, and after feeling about and making pressure on the salivary duct with the tongue, small spiculæ of calcareous material were expressed. This established the diagnosis of salivary calculus. A few days after the

expression of the small calculi, the pain, swelling and masticatory trouble recurred, followed by painful involvement of the tongue, the fauces, the pharynx; the condition became rapidly worse and within thirty-six hours the inflammatory swelling had increased to such an extent that swallowing, even of fluids was impossible, breathing was hampered and speech was absolutely incoherent, the pain and discomfort were almost unbearable and sedatives had but little effect.

Physical Examination.—Patient acutely ill, slightly dyspnœic and cyanotic. In the region of the right submaxillary triangle extending anterior to the submental region is a hard, firm swelling; the skin over it is œdematous but not red. The mouth can barely be opened. The tongue is elevated, and saliva dribbles from the mouth. The floor of the mouth is œdematous and indurated.

Operation.—Under local anæsthesia, Doctor Moschcowitz made an incision below and parallel to the right jaw, cutting the mylohyoid muscle and exposing the submaxillary, salivary gland which was œdematous and inflamed. On section, the gland showed small areas of suppuration with a definite abscess in the ampulla and a small, pea-sized calculus in the duct. The gland was excised. There was no frank pus in any of the spaces, but the tissues everywhere were œdematous. The wound was packed.

Following the operation the patient made an uneventful recovery and within three weeks all functions had returned to normal.

Case III.—*Probable glandular infection of the submaxillary triangle with secondary extension into the floor of the mouth, i.e., alveolar lingual sulcus and submaxillary space.* N. 19811. J. L., Russian, forty-three years old, married. Admitted, January 18, 1923, to Mt. Sinai Hospital. Discharged March 17, 1923.

History.—Patient had been under observation and treatment for a duodenal ulcer and was discharged from the hospital on December 7, 1922, to be readmitted on January 18, 1923, for a recurrence of the same condition. While the patient was in the hospital, about the 28th of February, he developed a swelling in the right, submaxillary triangle which was about the size of an egg and which appeared to be attached to the bone. The skin overlying this area was slightly red and tense. Fluctuation could not be determined. Examination of the floor of the mouth showed it to be free of infection, although the orifices of the submaxillary, salivary ducts appeared slightly inflamed. X-ray of the jaw was negative. Temperature 101. Pulse 80. On March 2, 1923, the patient was transferred to the service of Dr. A. V. Moschcowitz for incision and drainage of a submaxillary abscess. Under gas and oxygen, Doctor Colp made a two inch incision parallel to and below the mandible on the right side over the area of greatest swelling and after incising the superficial layer of the deep cervical fascia, a definite abscess cavity, about 2 cm. in diameter, was entered which contained about 5 c.c. of thick greenish pus. Two drainage tubes were placed into the cavity, being held there by iodoform packing. This pus later was found to contain an anhæmolytic streptococcus.

March 3.—When seen ten hours after operation, although the temperature was down to normal, the general condition of the patient was very much worse. He sat propped up in bed, definitely dyspnœic and slightly cyanotic. On physical examination, the external swelling was about the same, but now the tongue was elevated and protruding and there was marked œdema of the floor of the mouth.

The condition was evidently an acute spreading phlegmon of the floor of the mouth secondary to a submaxillary abscess, and because of the serious condition of the patient, it was deemed advisable to remove the submaxillary salivary gland. So, under local anæsthesia of one-half per cent. novocain, the original incision was prolonged posteriorly and anteriorly to the midline, the mylohyoid muscle was divided at right angles and the submaxillary salivary gland was bluntly dissected from below upwards. The gland itself was œdematous and friable. There was no free pus. The wound was loosely packed with iodoform gauze.

Almost immediately following operation, there was marked relief, the dyspnœa becoming very much less and the patient appeared generally more comfortable. Examina-

tion of the pharynx that afternoon by Dr. R. Kramer revealed moderate congestion and slight œdema of the epiglottis, pyriform sinuses and aryepiglottic folds. For this condition hot steam inhalations were advised.

March 4.—General condition of patient much improved. Œdema of the floor of the mouth very much less. Swelling in region of wound is markedly diminished. Wound appears clean.

March 5.—Examination of the pharynx by Doctor Kramer shows practically a normal larynx.

March 7.—Patient transferred to the medical side for treatment of his ulcer.

Note.—Patient has been seen several times in the Follow-up Clinic and except for a marked depression under his jaw on the right side, had no complaints to make.

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GASTRIC TETANY

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The term tetany does not indicate a disease entity. Tetany is merely a symptom or better, a syndrome; it is simply an expression of a disturbed function, and possibly of disturbed histological structure. It is known that one of the properties of nervous tissue, namely, excitability, is increased; and therefore it could be assumed that along with such alterations in function there must be a corresponding change in the structure involved; perhaps so slight and temporary that it can not be demonstrated with the means of investigation now at hand. At any rate, investigators state that no histological changes have been found in the peripheral nerves.

The causes of tetany and the conditions in which it arises as a complication are too many and varied, and therefore it can not be a disease entity in the strict sense of the word. Each causative agent produces a distinct type of tetany, clinically and chemically, *i.e.*, gastric, parathyroid, intestinal, tetany of pregnancy, etc.; although such differences might escape the careless physician who does not make a complete physical examination and an intelligent laboratory study of his cases.

McCallum and his co-workers have been able to demonstrate several points of great importance, showing that there are marked differences between the tetany due to pyloric obstruction and that due to parathyroid deficiency, proving that they are not the same condition. The following will illustrate the dissimilarities between the two conditions:

(1) Calcium lactate has a temporary effect in the twitchings and convulsions of gastric tetany, but never the decided controlling influence that it has in tetany following parathyroidectomy.

(2) The calcium of the blood is not changed or is only slightly increased in gastric tetany, being diminished in parathyroid tetany.

(3) There is a decrease in the chlorine of the blood plasma with a consequent increase in the alkali reserve in gastric tetany; not so in parathyroid tetany.

(4) The convulsive movements are different in these two conditions: the muscular rigidity and marked tachypnœa of parathyroid tetany are lacking, or less marked, in gastric tetany.

(5) The convulsions of gastric tetany can be prevented by administration of sodium chloride more readily than in parathyroid tetany, sodium chloride being superior in its efficacy in this respect to hydrochloric acid.

(6) A condition resembling gastric tetany may be produced by the ingestion of large amounts of sodium bicarbonate.

On the other hand, all types of tetany, no matter what the etiologic factor

has been, are characterized by intermittent tonic muscular contractions and by increased excitability of the peripheral nervous system. There must be, therefore, a fundamental similarity.

These muscular contractions with their resultant acid production seem to be the effort of nature to neutralize the alkalies which must be undoubtedly increased in the different types of tetany. Hence alkalosis must exist whenever the picture of tetany is present; but the mechanism by which this alkalosis is produced in one type, must be entirely different from that which produces it in the other types of tetany. We may say, therefore, that the immediate cause of the syndrome "Tetany" is alkalosis and that the administration of acids is a rational treatment, although with different intensity of effect in the various types.

History.—Tetany was first described by Dance (France) in 1831; and later by Steinheim (Germany), by Trousseau, who called it "Contracture rheumatismale des nourrices" (rheumatic contraction occurring in nursing mothers) and others.

Corvisart in 1852 introduced the term "Tetanie." Küssmaul in 1869 was, however, the first to write on tetany associated with gastric dilatation (gastric tetany).

Later Gerhardt, Dujardin-Beaumetz and Miller made descriptions of this same clinical condition.

Causes of Gastric Tetany.—Gastric tetany occurs very rarely without obstruction of the pylorus even if the stomach is much dilated (simple unobstructive dilatation).

It seems that in order to obtain the syndrome of tetany in connection with lesions of the stomach, there must be an obstruction of the pylorus which will prevent the discharge of the gastric acids into the intestines, whence they are absorbed.

In most cases the pyloric obstruction has been of a benign nature. (In three cases in which Mayo-Robson did pyloroplasty with very successful results, the pathological lesions at the pylorus were: cicatricial stenosis of the pylorus with hypertrophy; marked pyloric stenosis; and benign ulceration with adhesions to the gall-bladder, liver and abdominal wall).

Tetany does not appear to be a common occurrence in dilatation of the stomach due to carcinoma of the pylorus. Perhaps this is due to the fact that HCl is not secreted into the stomach, in this disease, being retained in the blood; and, therefore, in spite of the obstruction, there is not a removal of HCl from the organism, so that no hypochloremia or alkalosis could develop, which we know are essential characteristics of gastric tetany (Ashhurst); yet according to Trevelyan a few cases have occurred in connection with carcinomatous obstruction and with dilatation without obstruction.

The mechanism through which this pyloric obstruction, with its accompanying dilatation and retention, produces tetany, has been a problem to the profession for many years. Many different theories have been given; none being quite satisfactory as yet, and many of them having been thrown down

as false and discovered inaccurate by the strength and enlightening power of constant new researches.

Küssmaul thought the tetanoid contractions were due to the hypersecretion of the gastric mucosa and the constant vomiting which produced a dehydration of the tissues and concentration of the blood, this acting in some unknown manner on the motor centres of the central nervous system and, this in turn, on the abnormally dried up muscles, producing the contractions. An argument in favor of this hypothesis, at that time, was thought to be the occurrence of similar cramps in connection with the dehydration of cholera; but now it is believed that such cramps are due not to dehydration, but to absorption of toxins from the intestines. Against this theory of dehydration is also the fact that experimental tetany is produced by pyloric obstruction without dehydration, the normal balance of fluids being maintained by the introduction of liquids in the duodenum below the obstruction.

Germain See and Berlizheimer thought that tetany was produced reflexly by stimulation of the sensory nerves of the stomach, and to support such theories they stated that attacks were brought on by the passage of the stomach tube. However this is not a proof since the introduction of the tube seems to act in tetany in the same way that any external stimulation would act in cases of strychnine poisoning, that is, only as an exciting factor on the already abnormal organism.

Bouveret, Devic and Brieger held that tetany was due to an auto-intoxication, the toxins being produced in the stomach from the putrefying contents as result of the retention. In favor of this theory, some said, was the presence of leucocytosis and albuminuria usually present, but against it are several facts:

(1) That inoculations in animals of the untreated gastric contents of a case of tetany, produce no tetany. Probably the alcohol used by Bouveret and Devic in extracting their toxic substance (a toxin closely allied to syntonin and identical with the peptotoxin obtained by Brieger) was the cause of convulsions produced in their experiments.

(2) Many cases of dilatation of the stomach with retention did not develop tetany.

(3) McCallum and Murray found that tetany with pyloric obstruction developed more rapidly in those dogs which had their stomachs washed out more frequently, that is, when there was less stagnation and absorption.

(4) The albuminuria can be explained easily by the damage done to the kidneys by the chemical changes in the blood (alkalosis).

Another and still more recent theory and perhaps more accurate is that which explains the condition as being the result of the lack of absorption of HCl from the intestines, since it is retained in the stomach in consequence of the pyloric obstruction, this producing a condition of alkalosis in the system with its concomittant nervous irritability.

This theory seems to be a more intelligent explanation and one that agrees

with clinical findings, since tetany seems to occur whenever there is an excess of the alkali reserve in the organism. Among other conditions which produce alkalosis, besides pyloric obstruction, are the administration of large amounts of alkalies and excessive breathing; all of which frequently produce tetany.

Chemical Changes in the Blood in Gastric Tetany.—Murray found in his patients and in his experiments on dogs the following chemical alterations in the blood:

(1) High carbon dioxide capacity (highest was 107 per cent. vol.).

(2) A rise in the P_h—that is, the hydrogen ion concentration was diminished (alkalosis) due to a disturbance of the carbonic acid: sodium bicarbonate ratio; there being a rise in the bicarbonates which is not compensated by an equal rise in carbonic acid.

(3) Low chlorides content (2.5 gm. per litre).

(4) High urea concentration.

(5) Increased concentration of sulphur and phosphorus.

(6) A slight rise in calcium and a fall in sodium, resulting in a rise of the sodium-calcium ratio.

With all this valuable information at hand, what causes the nerve hyperirritability that expresses itself clinically in the form of tetany? It is true that almost all cases of gastric tetany show an increase in the blood urea, but this could easily be explained as a result of the alkalosis damaging the kidneys and preventing the proper elimination of the nitrogenous products; besides, we know that the immense number of cases of chronic nephritis encountered by every physician every day, never develop tetany. And we know that such cases almost invariably have a high blood urea content, but besides they show an acidosis instead of an alkalosis, and I think this accounts for the infrequency of tetany as a complication of nephritis. So that it is more reasonable to assume that the cause of this nerve hyperirritability is the alkalosis present. It has been shown that the introduction of alkalies increases irritability, some say by increasing the permeability of the nerve sheath. Whether this acts directly, or indirectly, by increasing the sodium-calcium ratio, is not known as yet.

Prognosis and Mortality.—When tetany arises in cases of dilatation of the stomach the recovery rate is low, only two out of ten cases.

Symptoms.—Consist in attacks of painful muscular spasm. Such attacks usually follow severe vomiting and sometimes occur after emptying or washing out the stomach. Frequently the first symptom is picking and numbness in the hands. The duration of the attack varies as well as the frequency. Sometimes they continue for days or even weeks. After the attack the patient usually complains of pain in the muscles involved, and for this, massage and passive movements are of great relief.

The hands and arms are especially affected. The hands take the peculiar shape known as the "obstetrical hand" (main d'accoucheur) with the thumbs and fingers adducted, the proximal phalanges flexed and the distal phalanges extended.

The lower extremities sometimes are affected, the feet assuming an equino-varus position. Convulsions may occur. The muscles of the neck, chest and abdomen are very rarely affected.

The increased irritability of the peripheral nervous system is demonstrated by the following signs, which though present in the majority of cases are not pathognomonic nor essential for diagnosis.

Trousseau's sign: spasms of the muscles when pressure is made, after the attacks, over the peripheral nerve or blood-vessels, so as to impede the venous or arterial circulation.

Chvostek's sign: spasms of muscles on tapping the motor nerves, especially the seventh cranial nerve.

Erb's sign: increased electrical excitability of peripheral nerves.

Hoffman's sign: paræsthesias and painful sensations produced by pressure and weak galvanic current on the sensory nerves. This is the least important of all the signs.

Schlesinger's phenomenon: painful supination of the foot when the hip is flexed while the knee is kept extended.

There is constant vomiting. The size and number of the bowel movements are reduced. There is a noticeable decrease in the amount of urine excreted; the skin and mouth are dry; the dryness of the mouth may be so pronounced that there is interference with speech. Thirst is constantly present. Finally the patient may become irrational.

There may be a leucocytosis averaging 31,000 (per cent. increase, especially in the polymorphonuclears): such high counts, some investigators say, cannot be due alone to the concentration of the blood. The red blood corpuscles are increased on account of the dehydration.

Albuminuria is usually present. This is said by some to be due to toxic substances affecting the renal epithelium, but recently it has been shown that ingestion of large amounts of alkalies (alkalosis) affects the kidneys, giving rise to albumen and casts in the urine and rise of nitrogenous substances in the blood.

The reaction of the urine is usually acid, in spite of the excess of alkali reserve present, and the explanation of this, is, that in order to get an alkaline urine (not due to ammoniacal decomposition, as seen in cases of retention with cystitis), the degree of alkalosis has to be exceedingly high.

Cases in which transitory blindness has occurred have been reported (Küssmaul, Bouveret and Trevelyan).

Some report that the pupils are dilated and do not react to light during the attacks, others say they are contracted.

There seems to be a general hypertonicity of the muscles (voluntary and involuntary) shown by certain symptoms like difficulty in starting urination and in part by constipation; probably the smooth muscles of the arterial walls and bronchi, being affected in the same manner, give rise to a high arterial tension, transient hæmiplegias and attacks of asthma, although no reference to

these symptoms has been made in the literature as far as I know. Dickson explained the feebleness of the pulse, observed during the attacks, as the result of spasms of the blood-vessels and probably this explanation may be applied to the amblyopia that sometimes occurs.

Treatment.—The main treatment is surgical, to relieve the obstruction: pylorectomy, pyloroplasty, gastro-enterostomy, etc., the last one being the commonest procedure whenever possible.

To help the condition the introduction of fluids is of great importance (water, 5 per cent. glucose solution, normal salt solution, etc.). There being a loss of hydrochloric acid and an alkalosis, the administration of such acid is of course a very rational treatment. HCl acid has been given intravenously in dogs and in combination with salt solution in man once, without any apparent deleterious effects. Of all the fluids NaCl (normal salt sol.) seems to be the best. McCallum found that it was more effectual than HCl in preventing tetany in dogs with pyloric obstruction.

Fluids should be given by every possible way: hypodermoclysis, intravenously, enteroclysis and axillary infusion.

The following case is from the surgical service of Dr. A. P. C. Ashhurst, Episcopal Hospital, Philadelphia, to whom I am indebted for the privilege and opportunity of reporting it.

W. C. L., age fifty-three, male, white, American. Admitted to hospital, November 15, 1923, died November 23, 1923.

Previous Medical History.—At the age of eighteen had a chancre and following this had a bubo. History of indigestion for the last ten years. Two years ago patient was in another hospital suffering with a gastro-intestinal attack. Patient states that an X-ray was taken then and that the duodenal cap was not seen. Patient received then intravenous treatment for syphilis.

Chief Complaint.—Pain in the epigastrium and constant vomiting.

History of Present Illness.—Patient has had vomiting for ten years; the pain in the epigastrium has been present only for the last month. Vomits immediately after taking any kind of liquid or solid food. The vomitus is slimy, no macroscopic blood nor bile. No history of hæmatemesis. Bowels are constipated; no blood in stools. Has been losing weight very rapidly (six months ago weight was 154 pounds, at present 125 pounds). Appetite is very good. Has some difficulty in passing urine and on several occasions has had sounds passed through urethra. Complains of dryness in the mouth and painful cramps in the arms and legs.

Physical Examination.—Patient is an adult, white, male of about fifty years of age, lies flat in bed groaning most of the time, with eyelids almost entirely closed. Speech is thick and difficult to understand. Scalp and ears are negative. Eyes: some exophthalmos present in both eyes. There are two opacities in the right cornea. Pupils are equal and react to light and accommodation. Nose is negative. Tongue is coated and dry.

Lungs: emphysematous; some moist râles at the end of inspiration in the right upper lobe anteriorly. Heart: apex beat is not felt; left border 1 cm. inside of midclavicular line. Abdomen: skin is dry and of poor elasticity. Recti muscles are very rigid giving to the abdomen a scaphoid appearance. There is an area of dullness extending about four fingers below the costal margin in the right hypochondrium; on palpation a mass could be felt in this same region. There is generalized rigidity and vague tenderness especially in the midline between the xyphoid and the umbilicus. There is also some tenderness in the left iliac fossa. Peristalsis is present. Scar in the left

inguinal region due to incision for bubo. Upper extremities: negative except that the forearms are kept in flexion at the elbow and the hands are contracted giving the obstetrical hand appearance. Reflexes not obtained. Lower extremities: muscles are very rigid; unable to flex the leg at the knee or the thigh at the hip. Reflexes could not be obtained due to spasticity. Veins are enlarged.

Urine and blood Wassermann are negative.

The day after admission (November 16, 1923) the following notes were made: Patient vomiting continuously; tongue is very dry; speech is difficult; great spasticity of lower and upper extremities, hands having the obstetrical appearance. Patient apparently suffering from tetany and dehydration. At 2 P.M. normal salt solution was given in the following way: Hypodermoclysis one quart. Axillary infusion one quart (one pint in each axilla without discomfort). Enteroclysis as much as possible.

Immediately after administration of fluid the patient felt much better: the tongue was moist, speech became clearer and the painful spasticity of the upper and lower extremities subsided to a great extent. November 17, 1923.—Patient was operated upon by Doctor Ashhurst. The following is the description of the operation (duodenostomy):

Local anæsthesia using 30 c.c. of 1 per cent. novocaine. Incision 10 cm. long through the upper left rectus. The stomach was found bound to the posterior abdominal wall by a mass in the prepyloric region. Upper end of jejunum not accessible due to adhesions. The duodenum was free from disease. Metastasis (?) in the left lobe of the liver and retroperitoneal masses. Liver and gall-bladder adherent to the stomach and to the anterior abdominal wall. A No. 24 Fr. catheter of soft rubber was sutured in the duodenum, above the ampulla, by Witzel's method (pointing down) with linen, and the duodenum was then attached to the parietal peritoneum. The cæcum was easily delivered into the wound, being apparently "undescended." The hepatic flexure of the colon was not a flexure, the colon apparently never having rotated. The descending duodenum had considerable mesentery and was freely mobile for an abnormally long distance below the pylorus. Wound closed with through and through silkworm gut sutures.

8 P.M.—Patient's pupils contracted, respirations 16 per minute (patient received by error before operation two hypodermics of morphine sulph. ¼ gr. at one hour interval).

November 18.—From the time after operation (11 A.M.) until 3.40 P.M. patient got through duodenostomy tube, 1 tablespoonful of 5 per cent. glucose and 2½ per cent. sod. bicarbonate every ten minutes—from then on until time of death he received 1 ounce of same fluids every 30 minutes.

November 19.—General condition good. Tetany has entirely disappeared.

November 20.—Patient irrational. Pulled rubber tube out and removed dressings. Still vomits immediately after taking of liquids. Tube replaced and fluids given at short intervals through rubber tube (f℥j *q.* 30 minutes) (30 c.c. every 30 min.)

November 22.—Patient delirious. Condition fair.

November 23.—Patient died. Just before death muscles of the upper extremities and face showed fibrillary tremors.

Autopsy Report.—Stomach was found enormously enlarged and in a dependent position. Length of greater curvature 45 cm. of lesser curvature 30 cm. There was a pyloric obstruction due to a thickened scar. The histological report of this area showed thickening of the pylorus, hypertrophied muscle and much fibrous tissue. So that apparently this was an obstruction due to an old healed ulcer, the obstruction being benign in nature.

Liver: Weight 1575 gms. Firm consistency; smooth surface; sharp edges. No evidences of metastasis. There were many adhesions in under surface. Enlarged retroperitoneal glands were found below the cœliac axis.

The case is of interest for the following reasons:

(1) It shows a clinical condition that for many years has puzzled the

mind of clinicians and investigators on account of its infrequency, its high mortality and its obscure etiology.

(2) The great improvement obtained immediately following the administration of normal salt solution. This seems to support the findings of McCallum as to the great preventive influence that sodium chloride has on tetany produced experimentally in dogs with obstruction of the pylorus. He found NaCl more efficacious in this respect than HCl. It is interesting to note, in connection with this point, that Dickson when discussing the therapeutic measures employed in the case reported by him (*The Practitioner*, January, 1903, p. 68) made the following statement: "The pronounced and almost immediate benefit from the subcutaneous transfusion of normal salt solution is a very important point."

(3) The ease, efficacy and safety of giving fluids by the method of axillary infusion. One pint (500 c.c.) having been introduced into each axilla without discomfort to the patient, within comparatively few minutes.

Comments.—1. Our patient had difficulty in urination and on several occasions sounds had been passed in the urethra. Dickson and others have reported similar findings. This might have been due to spasmodic contraction of the sphincter of the bladder.

2. We administered to our patient sodium bicarbonate, after operation, which procedure was not at all a rational treatment of the condition, since we know that there is already, in the system, an excess of alkalies, a fact that was overlooked at the time.

3. The operation performed in our patient was a duodenostomy, instead of any of the other operations that would relieve the obstruction, for reasons given above. Duodenostomy, however, did not correct the retention of HCl in the stomach and its exclusion from the blood stream, which we know is the main cause of gastric tetany.

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THE OPERATIVE TREATMENT OF DUODENAL ULCER WITH SPECIAL REFERENCE TO THE HORSLEY OPERATION*

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Whatever procedure we undertake in our operation for the repair or cure of duodenal ulcer, end results must be considered, while the type of operation to be done must be decided upon at the time of the exposure of the lesion. One cannot definitely say from the standpoint of the symptoms that such an operation should be done nor do the signs evidenced in our X-ray pictures definitely declare the type of operation that is to be, or can be done. The conditions that arise upon exposure of the lesion that make for the decision as to type of operation to be performed are in the main covered by the fixation of the duodenum at the site of the ulcer. The amount of contraction or stenosis of the duodenum. The amount of exudate present. The presence of a perforation. The involvement by means of attachments to the gall-bladder and pancreas, etc., etc.

Mobility of the involved portion of the duodenum readily lends itself to the operations of excision with or without plastic repair, such as the simple excision and suture if beyond the sphincter, the Finney pyloroplasty, the operation of Horsley and the more recent described operation of Charles Mayo. Fixation of the pylorus by means of adhesions, exudate, etc., with a well-established obstruction and gastric dilatation is most satisfactorily, from all viewpoints, operated upon by a posterior gastrojejunostomy. This class of patients to-day are my most satisfactory and grateful ones and are the most brilliant successes in gastro-intestinal surgery. The more recent radical operation of Finisterer, in which he advocates and practices the removal of the entire acid-bearing portion of the stomach, finishing with either a Billroth number one or two or completing after the method of Polya, has so far given him and others most excellent results. While having done this type of operation in numbers of instances when malignancy was suspected, especially in those patients in whom the ulcer and induration has been found to traverse the sphincter into the pyloric antrum, I am not as yet sufficiently satisfied that the operation is one that should be done in the duodenal ulcer usually found in the first portion of the gut. I am rather inclined to the belief that as time advances Finisterer will find more marginal ulcers reported following his procedure than he now admits.

The advantages of doing a plastic or resection operation upon the duodenum instead of a gastro-enterostomy are readily understood as in both

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instances, not only is the ulcer excised, but the entire mucous membrane of this portion of the duodenum is laid open to view, and in the event of a contact or kissing ulcer being present, excision of it can be accomplished either as an individual resection or as a resection of the involved area of the duodenum, followed by such repair as is most readily accomplished. On several occasions during the past few years, I have been able to demonstrate this condition and do a resection repair, whereas in doing a gastro-enterostomy, one leaves behind for a question of repair and subsequent hemorrhage, the pathology that was to have been cured. One cannot but admire the results in gastro-enterostomy or jejunostomy during the past years and more so after digesting the excellent article by Balfour published in the *Journal of the American Medical Association* of August this year. The results of the clinics at Rochester are without question arguments for the operation of gastrojejunostomy and must remain indubitable proofs of the value of this operation until such statistics can be assailed by the more modern operations. Nevertheless, with the records of marginal ulcer or peptic or of gastrojejunal, etc., that are being reported from year to year, be the per cent. two or ten as variously stated in print and verbally, one grasps for the ideal operation that should or will give not only a less per cent., but no per cent. Such being the issue, I have been casting about for some such type of operation until almost five years ago, when I was introduced to the operation of Horsley. In the arguments that followed his description or the mental notations that impressed me were two. The removal of the ulcer and the almost complete retention of the physiology of gastric digestion both as to proper period of maceration and attrition and the normal or almost normal chemistry. The slight deviation from normal is due to the division of the pyloric sphincter, thereby allowing, at least theoretically, a more rapid emptying of the gastric contents. As a result of the more rapid emptying, less maceration and attrition may take place. At the same time a slight modification in the gastric juice admixture may result. Neither of these arguments are worth the consideration given them in this description, as no apparent clinical manifestation of these are recorded by the patients, whereas it is well known that in the operation of gastrojejunostomy, the macerated pultaceous acid mass is ejected from the stomach into the jejunum, a distance of twelve to sixteen inches below the pyloric sphincter and meets with a surface and secretion not prepared for such insult, losing in transit all the admixture of the glands contained in the proximal twelve to sixteen inches mentioned. At the same time, I am compelled to admit that in several of my patients operated upon for a marginal ulcer, the lesion was found intra-gastric one-quarter to three-quarters of an inch from the anastomotic edge, while in the majority it was in the gastro-intestinal edge or in the jejunum.

The Finney operation has been for years an operation of election in very few patients in my practice, but in properly selected cases, its results are most encouraging.

The Polya operation advocated originally for carcinoma of the pyloric

antrum, etc., was used by me during its first years in America for quite a number of duodenal ulcer cases. I cannot mention too highly the excellent results obtained and know no reason why I ceased doing it for duodenal ulcer, except that I felt it was too great a mutilation as I do in Finisterer's methods now, especially so when obtaining such excellent results from the gastrojejunostomy.

Wanderlust does not obtain only in the human for sightseeing, but should be ever present with us in our attempts to improve our results. Such being a fact, my wanderlust has led me to almost five years of practising the Horsley operation with a result of over sixty of such operations to my credit, two of which died, one from pneumonia on the tenth day and one from a gas bacillus infection. One reoperation for a suspected marginal ulcer, not found, but a cholecystectomy added to my former operation, was followed with relief from all complaints now fully two years.

I do not do this operation in all instances, as I am still too thoroughly an advocate of gastrojejunostomy in selected cases. In those patients in whom I can mobilize the duodenum sufficiently to bring the first portion up to operating reach, I am accustomed for the past five years to do the Horsley. In those patients mentioned before, in whom we find a stenosis with a gastric dilatation, one should do either the operation of resection or a gastro-enterostomy. In those cases in which the ulcer is small and not accompanied with great infiltration and geographically out of sphincter bounds, resection with non-plastic closure should be done.

In perforations, it has been my custom for years to do an excision. This I did for years before Horsley's article was published, practically as Horsley's operation for non-perforated ulcers was described, but added to my plastic, a gastrojejunostomy, until having occasion to reoperate one of these patients, I found a much wider duodenum than normal at the site of my excision and plastic operation. Subsequent to this ocular proof, I have refrained from doing an added gastrojejunostomy. Furthermore, for years, irrespective of the type of operation, I have done an appendectomy and in more recent years, I have been adding a cholecystectomy. My associate, Doctor Carter, states that in seventeen per cent. of all patients operated upon two years ago, I did a cholecystectomy, while during the past twelve to eighteen months, the percentage of cholecystectomies reaches fifty. I am certain that during the past eight months, my percentage of cholecystectomies added to the plastic operations upon the duodenum will reach fully 75 per cent. More recently Doctor Carter, in re-reviewing this work, states: With all types of operation for duodenal ulcer previous to four years ago, cholecystectomy was 17 per cent. With Horsley in 1921, 23 per cent., had cholecystectomies and in 1924 up to November 1st, 80 per cent. had an additional cholecystectomy.

My reasons for the added cholecystectomy in the Horsley or Polya resection are that mobilizing the duodenum for plastic work is far more readily accomplished; that subsequent to a plastic on the duodenum, one is likely to have massive adhesions to the gall-bladder that in themselves are vicious

symptom producers and that observation after a cholecystectomy in several patients, who had previously had plastic operations done in this segment of the digestive canal, were convincing enough by benefits obtained to call for a further trial at removal. Furthermore, as a large proportion of these patients have chronic cholecystitis at the time of operation, this fact should be placed first on the list of arguments in favor of an added cholecystectomy.

Not to neglect that part of the beginning of this article, "that end results must be considered while the type of operation must be decided upon at the exposure of the lesion." Of the *End Results:* the most important in the mind of our patients is that of mortality, while to the operator failure or not entirely successful, are the end results dreaded. Sandwiched between the cures and failures, we have the improved but not wholly cured patient, who gives us almost as much or really more concern as the failure. All of the operations considered are so far in our statistics productive of about the same result, with marginal ulcer in the foreground in the operation of gastrojejunostomy and in all fairness to the advocates of this operation, more than likely due to the fact that it is the operation of choice of most surgeons. That the resection and plastic operations are markedly less in number and have fewer years to their credit for the possibilities of forming marginal ulcers.

In this class of end results, I have two patients, one over eight years and one over seven years' duration after gastro-enterostomy before developing a marginal ulcer.

The mortality in Horsley's operation should not be any greater than in Finney or in gastro-enterostomy. The class of improved but not cured patients, I am inclined to believe from a theoretical physiological viewpoint, should be more in gastrojejunal operations than in the Finney or Horsley or Finisterer operation and from a distinct surgical viewpoint, there can be no question about the cure of the ulcer where it is excised as in the Horsley operation or Finisterer or Charles Mayo, whereas in the operation of gastrojejunostomy, the lesion is left to repair if it will. I am positive that in three patients with bleeding in the post-operative period of two weeks, when I reopened the stomach, that the bleeding was due to the retained ulcer. I am also sure that the bleeding in the late post-operative period in gastro-enterostomies, seen now and then, comes from the retained ulcer or ulcers. Granted also that a new ulcer may or does form in these patients, the evidence of a retained ulcer always remains as a strong argument in defense of those operations in which the ulcer is removed.

Marginal ulcers after operations upon the stomach and intestines are stated as occurring in from two to four to ten per cent. Written or printed statistics vary from two to four per cent. Recently I have had a personal communication from a surgeon of experience who feels that ten per cent. would be an average occurrence. This I cannot or do not wish to believe is correct when I recall the statistics of our large clinics and my own work. I am also aware that our own work does not always return to us for repair.

The causation of these marginal complications has been gone into by many authors. Personally, I have reported a series of patients in an article in the ANNALS OF SURGERY, etc., in which all possible sources of error in the operation that might have provoked the origin of the ulcer were discussed, beginning with the non-absorbable suture as a foreign body irritant and entering into details of the traumas by means of clamps, used in various ways. The possibilities of hæmatomata and thrombosis, etc., finally closing the argument on etiology by admitting being at loss to definitely locate a cause, and stating that owing to numerous (seven in one instance) operations in one individual, even done with absorbable material throughout and without the use of anastomotic clamps; that until we could find a more definite cause, we must accept a personal idiosyncrasy to ulcer formation in many patients.

In a personal communication to me recently, Horsley described his latest modification in his suture, being very meticulous as to the placing of sutures so as not to involve the mucosa. If the stitches through the mucosa are so productive of ulcer in the experimental work, I am sure we should have a greater proportion of ulcers than we now do. I am as careful in sewing my mucous membrane together as I am in sewing the skin, fully believing that if one leaves a gap in the mucous membrane to repair by granulation, he will have the same tendency to ulceration that a granulating gap in the skin edge will have. In fact, in view of the irritating contents and the activity of the stomach and intestines, the tendency to ulceration should be far greater if proper apposition is not obtained. We have observed (myself and assistants) that the post-operative period in Horsley, Charles Mayo, Polya, Finney and allied operations is smoother than in the gastro-enterostomies. There are less vomitings and far less occasion for lavage.

Finally, may I be permitted to record the following: That the Horsley, Charles Mayo and Finisterer operations are too recent and too few done to definitely stamp them as the operation to do, but that the Horsley and Charles Mayo operations are indicated in those patients in whom the duodenum can be mobilized and in which the ulcer is within one and one-half inches of the sphincter and where a definite stenosis does not exist.

In addition to the fifty-six patients cited, there were seven outside of New York Post-graduate Hospital service and two Horsley modifications in attempted Rhansted operations for congenital stenosis of the pylorus. We also advised the Horsley operation in two infant patients of Doctor Sillick, one of our Post-graduate surgeons, with pyloric stenosis, which were followed by successful issue.

In reviewing fifty-six operated patients' histories and follow-up, Doctor Carter reports a symptomatic ulcer cure in 94 per cent. of those reporting. That ulcer and gall-bladder symptomatic cures were 80 per cent. ulcer cure with gall-bladder symptoms persisting in 24 per cent.

That the gall-bladder symptoms are the following: Fullness in the epigastrium after eating and amounting to distress, radiating to the precordia

not constant. Periods in which food disagrees but does not cause pain. Soreness and pain referred to the back and shoulder.

While the ulcer symptoms taken to be those persisting before the operation are in particular the following: Pain with a definite time ratio to food intake relieved by food or alkalies; vomiting, nausea, hemorrhage and failure to gain weight. These follow-up conclusions by Doctor Carter speak very strongly for the added cholecystectomy mentioned earlier in the paper.

In the fifty-six cases under observation at the Post-graduate Hospital and considered in the follow-up clinic, one had an additional choledochostomy, one a cholecystostomy nine years before, one followed a gastro-enterostomy sixteen months previous and was operated upon for a marginal ulcer with repair of this anastomosis and immediately associated with a Horsley. Eighty-four per cent. had an appendectomy done at the same time. Realizing that surgery is but a mechanical repair, I do not rest with the operation for the ulcer alone, but suggest to the family physician that all other sources of discovered infections, teeth, tonsils, etc., be cleared and that the patient be carefully observed by him as to diet, alkalies, etc., for not less than six months and preferably a year following the operation.

NOTE.—We have been able to trace 84 per cent. of all patients operated upon by the Horsley method during this time.

ACUTE INTUSSUSCEPTION IN CHILDREN *

OBSERVATIONS ON THIRTY-ONE CASES ADMITTED TO THE CHILDREN'S HOSPITAL IN PHILADELPHIA

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By constant improvement in diagnosis and operative technic, modern surgery has made wonderful strides in reducing the mortality of many of the diseases amenable to surgical treatment, one of the outstanding exceptions being acute intussusception in children. In spite of earlier diagnosis and definite improvement in operative technic the mortality accompanying this condition is still almost appalling, as shown by the published reports from various clinics, Australia being the one notable exception.

Eccles [2] in 1898, reports a mortality of forty-five per cent. in children operated upon within twenty-four hours of the onset, and sixty per cent. when operation was done on the second day. Gibson [3] in 1900 reports a thirty-seven per cent. mortality on the first day and thirty-nine on the second. Coffey [1] in 1907 says the mortality runs from seventy to ninety per cent., and Torrance [10] in 1907 quotes Kimpton as stating that at the Massachusetts General Hospital from 1908 to 1917 there were sixty-three cases with a mortality of forty-nine per cent. Perrin and Lindsay [7] in 1915 report a mortality of thirty-five per cent., and Kahn [5] had a twenty-five per cent. mortality in twenty-five cases.

The report of Hipsley [4] stands out as a brilliant achievement in a mass of literature which is otherwise but little more than a record of comparative failure. His fifty-one cases without a death when operation was performed within thirty-six hours of the onset of the condition is the most brilliant example of the treatment of intussusception that I was able to find after a fairly careful survey of the more recent literature. Having only four deaths, one just over thirty-six hours, two after three days and one at four days, is indeed a remarkable attribute to his ability as a surgeon. In his series only once did the child survive after resecting a part of the bowel, the two other cases in which this was necessary having died.

Anyone doing pediatric surgery knows only too well that the vast majority of resections of an intussusception end fatally. This is shown by the fairly numerous isolated case reports in which this procedure has been successful, very few of the surgeons, however, stating how often resection has proven disastrous at their hands. In this connection the four cases mentioned by Straus [9] in which he resected the involved area and the patients recovered, is a splendid achievement. Rischbeith [8] in 1900 had only heard of three cases, to which he added a fourth. There is apparently only one efficient method of preventing this high mortality, and that is early diagnosis and operation before the condition has progressed to the stage where reduction is impossible. Even

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when reduction can be accomplished the mortality is far greater than is justifiable, Hipsley's record excepted. This varies according to different surgeons, from thirty-six per cent., Gibson,[3] to seventy or eighty per cent., as observed by Coffey.[1] Several men comment on the fact that there seems to be some as yet undetermined factor in intussusception not encountered in other of the more serious abdominal conditions, which produces a fatal outcome in these cases. In a large proportion, recognized and operated upon within twenty-four hours of the onset, in which reduction is easily accomplished, and when it appears as though the child had suffered but little from the operation, *per se*, within twenty-four to forty-eight hours or sooner it becomes extremely toxic and dies.

FIG. 1.—Œdema of bowel wall preventing reduction of intussusception.

In the series from the Children's Hospital which I wish to report we have frequently observed this phenomenon, and so far are at a loss to account for it. This ante-mortem toxic manifestation was noted in thirteen instances in which the intussusception had been reduced and twice when reduction was impossible. Only three times was the notation made that the children were not toxic before death. In the remainder no observation was recorded as to the presence or absence of the condition.

The theory that absorption of toxins from the intestinal tract is responsible for the sudden death of these cases is one of the most plausible advanced so far, especially in view of the fact that we see a somewhat similar condition in acute obstruction in adults when the upper part of the bowel is involved. It is quite conceivable that in an infant under one year of age with an intussusception, but a very small amount of toxins would needs be absorbed to cause a fatal outcome. A high jejunostomy, as advocated in acute obstruction in adults, was not attempted in any of the cases. In those in which reduction was easily accomplished it apparently did not seem indicated, and in the very toxic the surgeons in charge evidently did not consider that the child's condition warranted this further operative procedure. Tuby [11] in discussing

a paper by Bernard Pitts, suggests that: "Continued toxicity may be due to thrombosis of the mesenteric veins corresponding to the apex of the intussusception, which was an indication of the acute septic infection originating in the damaged condition of the bowel. The rapid spread of the thrombosis was the explanation of continued pyrexia in the cases of this type which end fatally." In the cases coming to autopsy at the Children's Hospital no mention was made of any such condition of the mesenteric veins, but it is of course quite possible that this was overlooked by the pathologist.

Our observations during the past nine years show that a correct diagnosis is being made more frequently and these patients referred earlier for operation, but there is no doubt that in still far too many, the physician in charge either fails to recognize the intussusception or hopes to reduce it by rectal injection of one form or other and only refers the little patient to the hospital as a last resort.

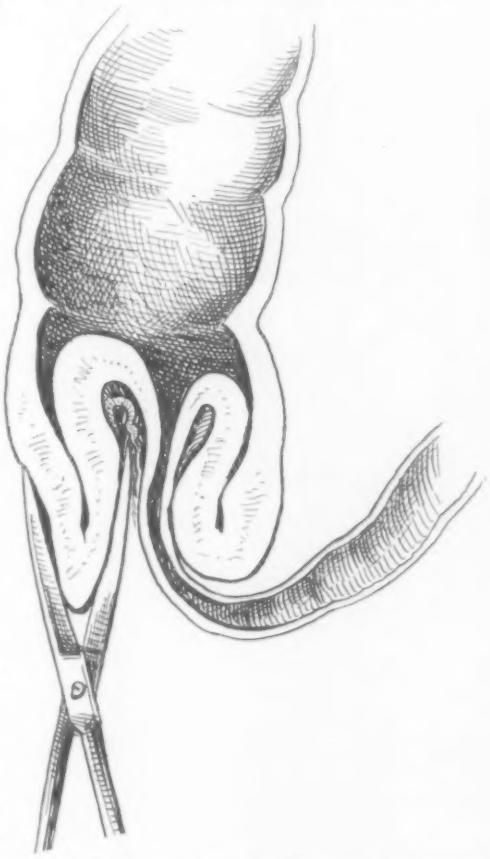

FIG. 2.—Blade of Mayo scissors inserted to cut constricted neck of intussusception.

For frequency of occurrence Australia again leads, Kelly [6] in discussing Hipsley's paper, remarking that he had seen forty cases in two and one-half years at the Children's Hospital in Melbourne. In the Children's Hospital in Philadelphia, there were admitted thirty-one cases in nine and one-half years. Eccles [2] reported twenty-eight in St. Bartholomew's Hospital from 1871 to 1880, and forty from 1891 to 1896. At the Massachusetts General Hospital, Torrance [10] states that there were sixty-three cases from 1908 to 1917. The reports of various writers bear out the fact that except in Australia the condition, while by no means rare, could scarcely be regarded as one of common occurrence.

Numerous theories have been advanced in explanation of the etiology of intussusceptions involving the cæcum and terminal ileum, the most rational of which appears to be that promulgated by Perrin and Lindsay.[7] By combining the views of other observers, they show that in an infant the ileo-cæcal valve projects about three-eighths of an inch into the cæcum, and the terminal ileum is surrounded by a very rich lymphatic supply. Due to disturbances in diges-

TABLE I.

No.	Hosp.	Name	Age	Sex	Mass	Feeding	Condition on admission	Type	Duration	Operation	Result	Remarks
1.	562	G. F.	1 yr.	M.	Palp.	Breast and bottle	Good	Il-cae.	48 hrs.	Reduce, suture ileum	Recover	Ileum sutured to abd. wall.
2.	696	L. D.	4½ mos.	F.	?	Breast	Fair	Il-cae.	48 hrs.	Irreduc.	Died	Ileum anastomosed to colon. Intuss. left outside abd. Died 9 hrs. later.
3.	37	J. L.	7 mos.	M.	Palp.	Breast, 3 mos.	Quite toxic	Il-cae.	36 hrs.	Irreduc.	Recover	Resect. Murphy button anast.
4.	414	M. B.	4 mos.	M.	Palp.	Breast	Very toxic	Il-cae.	3 days	Irreduc.	Died	Eviscerated 7th day post-op. Mass brought outside abd. and drained. Died in 1 hour. Op. 25 min.
5.	440	P. D.	7 mos.	M.	Palp.	Breast	Toxic	Il-cae.	4 days	Reduce	Died	T. 107, P. 136, R. 60 at death, 5½ hours after op.
6.	75	M. S.	11 mos.	F.	Not palp.	Breast	Very toxic	Il-cae.	4 days	Reduce	Died	T. P. R. 105–158–60 at death, 10 hours after op. Bowel good.
7.	361	B. B.	1 yr.	M.	Palp.	Breast, 9 mos.	Toxic	Il-cae.	5 days	Irreduc.	Died	Ileo-colostomy. Lived 7 hours.
8.	222	F. G.	4 mos.	M.	Palp.	Breast	Very toxic	Il-cae.	3 days	Irreduc.	Died	Resection. Anastomosis.
9.	26	H. B.	8½ mos.	F.	Palp.	?	Good	Il-cae.	24 hrs.	Reduce	Recover	Appendectomy. Cæcum sutured to abd. wall.
10.	300	W. B.	9 mos.	M.	Palp.	Breast	Fair	Il-cae.	3 days	Reduce	Died	Diarrhœa and bloody stool for one month. Died 6 hrs. T. 105, P. 148, R. 54.
11.	423	M. R.	10 mos.	F.	Not palp.	Breast, 6 bottle 4	Good	Mid-ileum	25 days?	Reduce	Died	Intuss. easily reduced. Poor reaction. Died in 12 hrs.
12.	647	E. M.	5 mos.	F.	Palp.	?	Good	Il-cae.	3 days	Reduce	Died	T. 106, P. 148, R. 36 at death in 72 hrs.
13.	378	J. C.	3 mos.	M.	Not palp.	Breast	Good	Il-cae.	48 hrs.	Reduce	Died	T. 107, P. 140, R. 60 at death. 5 hrs. post-op. Poor reaction.
14.	259	R. N.	4 mos.	M.	Not palp.	Breast	Fair	Il-cae.	6 days	Irreduc.	Died	Resect anastomosis. Died in shock.
15.	189	D. R.	1 yr.	M.	Not palp.	Breast	Good	Il-cae.	24 hrs.	Reduce	Recover	Developed diphtheria.
16.	180	A. K.	10 mos.	F.	Palp.	Breast 6, bottle 4	Fair	Il-cae.	5 days	Irreduc.	Died	Ileostomy. Died from shock. Time of op. 20 min.
17.	328	M. J.	6 mos.	M.	Palp.	?	Good	Il-cae.	48 hrs.	Reduce	Died	Fecal vomiting next day. Died 48 hrs. post-op. Cæcum sutured to ant. abd. wall. Op. 25 min.

18.	281	D. P.	8 mos.	M.	Palp.	Breast	Good	Il-cae.	5 days	Irreduc.	Died	Resect. Murphy button anast. Ileostomy above anast. Died in 1 hr.
19.	217	S. C.	10 mos.	M.	Palp.	Breast	Good	Il-cae.	24 hrs.	Reduce	Died	Papilloma resected from terminal ileum. Lived 60 hrs. Op. 20 min.
20.	734	L. D.	14 mos.	F.	Palp.	?	Poor	Il-cae.	24 hrs.	Reduce	Died	Died 1 hr. after operation. T. 103, P. 136, R. 48.
21.	760	G. C.	6 mos.	M.	Palp.	?	Poor	Il-cae.	48 hrs.	Reduct. not attempted	Died	Constipation, vomiting, bloody stool and convulsions. Died as operation was started.
22.	797	A. B.	5 mos.	F.	Palp.	Breast	Good	Il-cae.	12 hrs.	Reduce	Lived	Anchor suture to ant. abd. wall.
23.	430	H. H.	6 mos.	M.	Palp.	Breast	Good	Il-cae.	3 days	Reduce	Died	Mass palpable in rectum. Easily reduced. Operation 18 minutes.
24.	309	J. D.	8 mos.	M.	Palp.	?	Fair	Il-cae.	8 hrs.	Reduce	Lived	Anchor suture to ant. abd. wall. Time of operation 10 minutes.
25.	777	A. A.	6 mos.	M.	Palp.	Breast	Good	Il-cae.	24 hrs.	Reduce	Lived	Appendectomy. Anchor suture.
26.	800	R. C.	4 mos.	M.	Palp.	Breast	Good	Il-cae.	24 hrs.	Reduce	Died	Mass extended to rectum. Difficult to reduce. Appendectomy. Anchor suture. Left table in good condition. At death T. 105, P. 166, R. 68.
27.	9	A. I.	6 yrs.	F.	Palp.	.....	Good	Mid-ileum	24 hrs.	Reduce	Recover	Dark red cauliflower tumor, the intussusception, in mid-ileum, reduced. No biopsy. Tumor was hæmangiosarcoma.
28.	243	M. V.	8 mos.	F.	Palp.	Bottle	Good	Il-cae.	36 hrs.	Reduce	Lived	Anchor suture.
29.	351	R. S.	9 mos.	M.	Palp.	Breast	Good	Il-cae.	3 days	Reduce	Lived	Intuss. to splenic flexure. Easily reduced and anchor suture to abd. wall.
30.	469	R. C.	7 mos.	F.	Palp.	Breast	Good	Il-cae.	32 hrs.	Irreduc.	Died	Constriction incised as described in text.
31.	549	S. T.	6 yrs.	M.	Palp.	.....	Good	Il-cae.	15 days	Reduce	Lived	Congenital deformity of bowel.
32.	525	R. C.	6 mos.	M.	Palp.	Breast	Good	?	5 weeks	?	Lived	Mass felt 3 cm. within rectum. Operative permission refused. Colic, bloody stools, loss of weight for 5 weeks. Improved. Left hospital against advice.

tion, which are more likely to occur after the fifth month when the child's diet is usually changed—the largest proportion of intussusceptions occurring from the fifth to the ninth month—the lymphatics are swollen, and the terminal ileum, projecting into the cæcum, acts as an irritant and increases peristalsis. They agree with others that the most logical suggestion accounting for the condition being more frequently seen in healthy children is that in these the lymphatic tissue is better developed.

So much has been written of the symptoms and physical signs that it is not necessary to enumerate them here, sufficient to say that when a mother states that her child, having been otherwise perfectly well, suddenly screams, vomits, turns pale and gets quickly better, followed by attacks of crying, fretfulness and apparent abdominal pain, associated with blood or bloody mucous in the stool, the physician in charge should regard the case as one of intussusception

TABLE II.

Duration of intussus.	No. of cases	Reduced		Not reduced		Per cent. mortality according to duration of intussus.
		Lived	Died	Lived	Died	
24 hours or less	9	6	3	0	0	33.3
48 hours	9	2	5	1	1	66.6
72 hours	6	1	3	0	2	83.3
4 days	2	0	2	0	0	100
5 days	3	0	0	0	3	100
6 days	1	0	0	0	1	100
Over 6 days	1	1	0	0	0	0
Total for series	31	10	13	1	7	64.5 per cent. mortality

until he is definitely able to prove it otherwise. In this connection, a correct diagnosis having been made, any attempt on the part of the family physician to reduce it by the injection of fluid by rectum is mentioned merely to be condemned. The only circumstance under which this procedure seems justified in our present day is the extremely rare one in which it is impossible to reach a surgeon and have the child operated upon. There are indeed very few parts of the country where the services of a competent surgeon cannot be procured within twelve hours.

The basis of the present paper is a study of thirty-one cases admitted to the Children's Hospital in Philadelphia, from 1915 to 1924, and with the realization that this constitutes but a very small series, no attempt has been made to deduct any conclusions. The results were so discouraging when compared to Hipsley's that we would indeed be very pessimistic were we to accept them as the final standard of our efforts. I am indebted to Doctors Jopson, Hodge, Allen, Speese and Lee, upon whose services the cases were admitted, for the privilege of reporting them.

From an etiological viewpoint it was of interest to note that one case was due to a papilloma of the terminal ileum, one had an hæmangiosarcoma in the mid-ileum, and one had an unusual congenital deformity of the intestine (to be reported by Doctor Lee). All of the others originated in the ileo-cæcal

region and were included under the general term of ileo-cæcal, no attempt having been made to further subdivide the classification. In this series twenty-four or sixty-four and one-half per cent. occurred in the second half year of life, nine before this time, the remaining two being over two years of age. The period of greatest frequency thus coincides with that of the other published reports.

Where it was so stated in the history, sixteen of the children were breast and one a bottle fed infant, a fact which tends to bear out the theory advanced by Perrin and Lindsay that change in diet (usually weaning) would account for possible intestinal irritation with subsequent enlargement of the lymphatics, etc.

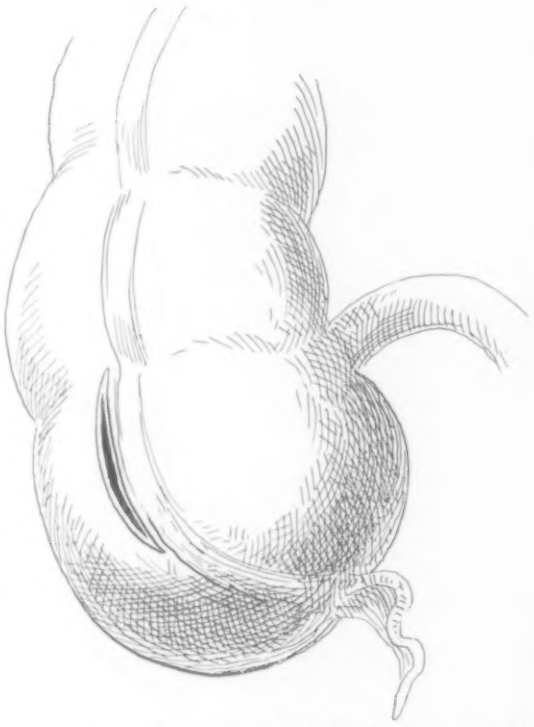

FIG. 3.—Opening in cæcum resulting from incision made in Fig. 2. Note.—The œdema of the bowel wall is more marked than is shown in the drawing.

The mortality of those cases operated upon within twenty-four hours of the apparent onset of the condition, the most favorable time for surgery, is very discouraging. Nine cases were seen, all reduced by operation, six of which lived and three died, a mortality of thirty-three and one-third per cent.

In the forty-eight-hour period nine cases were operated upon, three of which lived. Two of the latter were reduced, and in one a resection was done, this being the only resection in the series which survived. Doctor Jopson operated upon this child and has reported it elsewhere. In four instances reduction was possible and yet the children died, and one other, irreducible, ended fatally.

In this period there was one case showing the typical signs of intussusception, in addition to which a mass could be felt three cm. within the rectum. The parents refused operative permission, the bloody discharge cleared up and the patient left the hospital against advice in eleven days, apparently recovered although the notes say that the child still had mucous in its stool. This case is not included in the series because the child was not operated upon, and consequently the tumor was not actually observed. Of the six cases admitted on the third day, four were reduced, three of which died, and two, both irreducible, ended fatally, a mortality of eighty-three and three-tenths per cent.

Two seen on the fourth day died, both having been operated upon and the intussusception reduced. Three on the fifth and one on the sixth, all irreducible at operation, all died. In one case, seen on the fifteenth day, a congenital deformity of the intestine was the cause of the intussusception. The intussusception was reduced and the child lived.

Thus ten reduced and one resected case lived, while thirteen reductions and seven in which resection or other operative procedure was performed, all died, a general mortality of sixty-four and five-tenths per cent. Where reduction was possible, regardless of the duration of the condition, thirteen of twenty-three cases died, a mortality of fifty-six and five-tenths per cent. In the eight in which reduction was impossible, only one survived, a mortality of eighty-seven and one-half per cent.

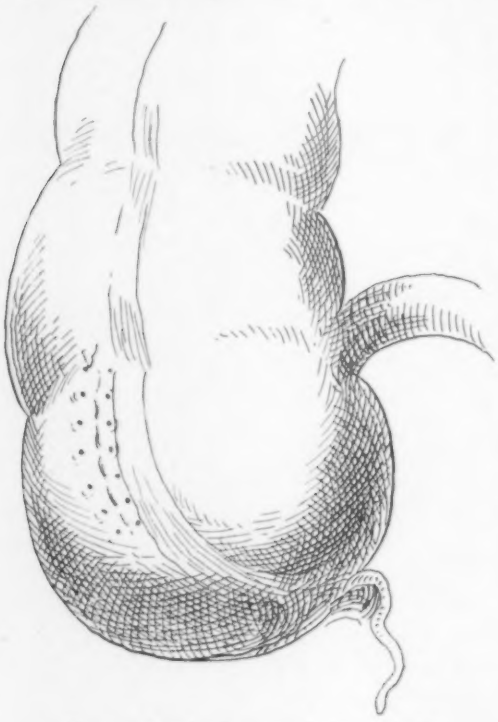

FIG. 4.—Opening in cæcum has been closed.

In this series neither the severity nor variety of symptoms—bloody stool, vomiting, abdominal pain or palpable abdominal mass—seemed to influence the outcome, some of the most severe having recovered and some of the mildest having died.

There is only one case which I wish to report in detail, for in this a procedure was employed which I have failed to find in a review of the recent literature. When one considers how voluminous this is, it is very easy to see how such a reference could be overlooked, and I feel quite certain that the method has been employed before, but I have been unable to find such a record.

A well nourished female infant of seven months, apparently in good condition, was brought to the hospital thirty-two hours after the onset of vomiting, bloody stool and drowsiness. A mass was palpated in the rectum and operation done immediately.

Upon opening the abdomen it was found that the intussusception, having started in the ileo-cæcal region, extended to the sigmoid. Reduction was readily accomplished to within the terminal four cm. of the mass where further reduction by "milking" and traction was impossible. Hot cloths were applied for several minutes and reduction again attempted, but it only succeeded in tearing the serous coat of the intestine in several places. The circulation of the bowel and mesentery was apparently good, as shown by its color, but the walls were so œdematous that further reduction could not be accomplished. Realizing that resection would in all probability be fatal, it was decided to incise the constricted neck of the intussusception. This was done by inserting one

blade of a pair of Mayo scissors, in the a-mesenteric border of the bowel, between the intussuscipiens and intussusceptum, Figs. 1 and 2, and cutting the constricted neck of the intussusception. When this simple procedure had been carried out, reduction was accomplished with the greatest ease, Figs. 3 and 4 the two and one-half cm. incision in the cæcum being readily closed with catgut and a continuous Lembert suture of linen. The rents in the serous layer of the bowel, made while trying to reduce the intussusception, were closed, and a small rubber covered drain inserted through a separate stab incision in the right iliac fossa and the abdomen closed in layers. The operation was accompanied by considerable shock, the child was given normal saline solution by hypodermoclysis but failed to respond and died eight hours later. The temperature on admission was 102°, the pulse 156 and respirations 40, and at death they were 107°, 180 and 84, respectively. Upon reopening the abdomen there was no evidence of intestinal leakage nor recurrence of the intussusception and I feel that the child died a toxic death in spite of rather than because of the operation.

It is suggested that in selected irreducible cases in which the gut is obviously not gangrenous nor the mesentery thrombosed, the œdema of the bowel preventing reduction, before deciding to resect the involved area by any of the recognized methods, it might be advisable to make an incision similar to the one described and reduction attempted. Should this still be impossible or it be ascertained that the bowel is not viable, resection could then be readily done. I believe that in the case reported, had the bowel been incised as described as soon after further reduction became difficult and had time not been wasted in what proved to be useless attempts to accomplish it, the child's chances for recovery would have been far greater.

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ASEPTIC END-TO-END INTESTINAL ANASTOMOSIS*

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In 1921 an instrument for use in intestinal anastomosis was devised by the writer and experiments upon dogs were carried out for over two years,

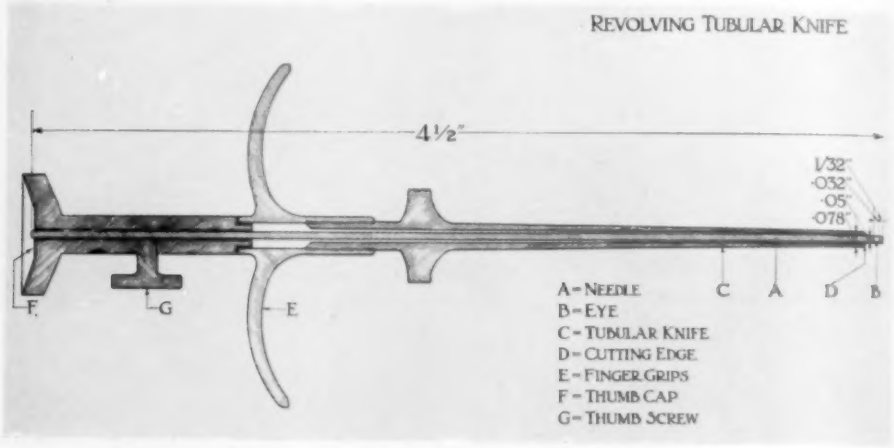

Fig. 1.—Sagittal section of tubular knife, actual size.

during which time 86 end-to-end anastomoses were performed. The object of this study was to develop an operation which would be safe, easily per-

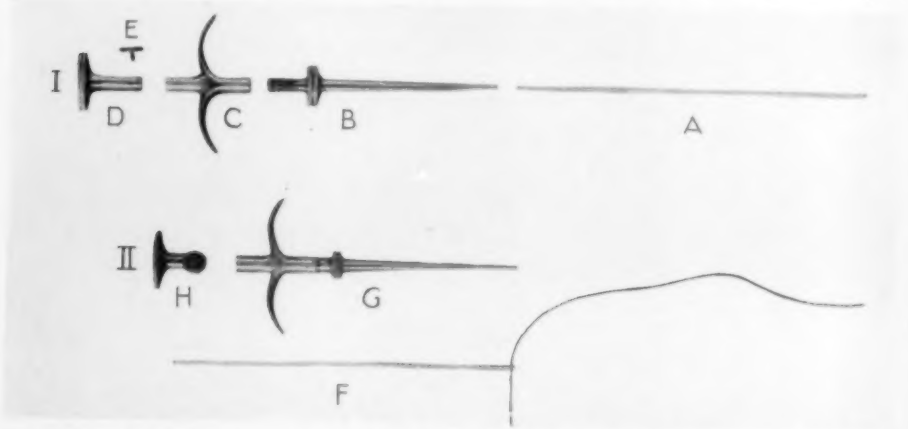

Fig. 2.—I. Instrument completely disjointed. II. Assembled for operation. A. Cylindrical needle. B. Tubular knife with cutting edge at one end and knurled wheel and threads at the other. C. Steel tube with finger grips into which B is screwed and D fitted. D. Tubular thumb-cap. E. Thumb-screw. F. Needle threaded with catgut. G. Knife assembled. H. Thumb-cap assembled.

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formed, suitable for all portions of the intestine, not followed by adhesions, and which would restore the bowel anatomically and physiologically in the shortest possible time.

End-to-end intestinal anastomosis is generally held to be more ideal than either the lateral or end-to-side anastomosis, but the great objection to the method has been the danger from poor blood supply opposite the mesenteric border and from stenosis and obstruction to the lumen by the diaphragm at the line of union. That an operation of this type which eliminates contamination of the peritoneal cavity from the bowel contents is most desirable and that the ideal has not been attained is evidenced by the amazing number of methods advocated in recent years for performing aseptic end-to-end anastomosis.

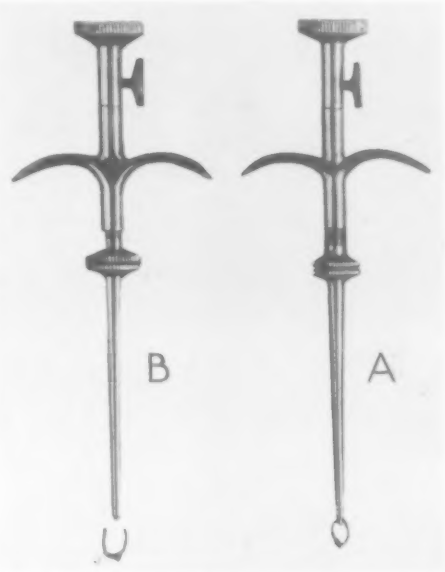

FIG. 3.—Instrument completely assembled. A. Ready to cut the catgut ligature. B. With the catgut severed.

Halsted, who did more perhaps than any other investigator to stimulate interest in intestinal anastomosis, said in 1912:[1] "As to the simple excision of a loop of bowel, this can be carried out as cleanly and as aseptically as the resection of the appendix. If it sufficed merely to sew together the abutted ends of the gut, each end having been treated after the manner of an appendix stump, the problem would seem to be solved. The wall of the bowel having been reduced to its submucous coat by crushing or otherwise, firmly ligated, and cut through with a Paquelin cautery, the division of the gut is accomplished asepti-

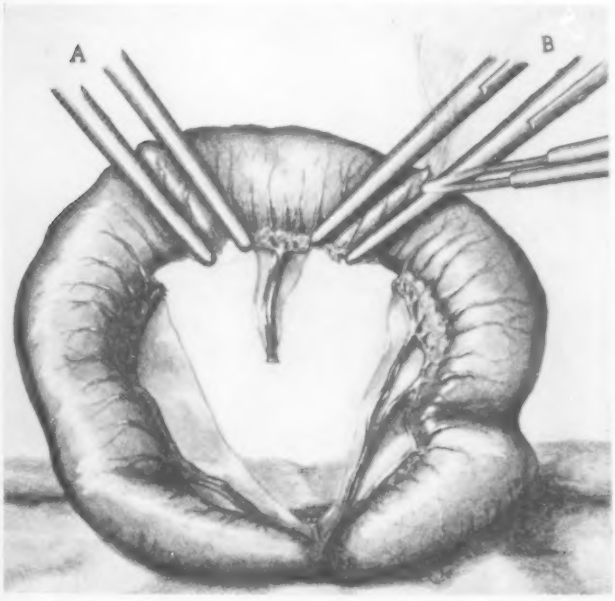

FIG. 4.—Segment of bowel being excised. A. Parallel clamps placed slightly obliquely on the bowel at a short distance from the denuded mesenteric border. B. The bowel is being divided with a cautery close to the outer clamp.

cally. The two free ends can now be abutted and sewed together without manifest flaw in the technic. But a double diaphragm remains to impede for a long time the advance of intestinal contents even if the ligatures employed in the tying-off of the gut could be relied upon to melt away with the desired promptness." At that time Halsted devised an operation in which he used a bulkhead suture. In a final method devised just before his death, he sewed together the abutted ends of colon which had been closed off with purse-string sutures, and proceeded to cut the ligatures by means of a knife on a flexible metal gas-pipe, inserted per rectum by an assistant and threaded along the large bowel to and through the diaphragm. A bougie was then passed to make certain that the lumen had been reëstablished. Although he reported excellent results in animals, he could work only on the large bowel, the method was obviously unsatisfactory, and was never tried on the human subject. This work stimulated several men to devise a means whereby the occluding ligatures could be released in a less cumbersome way.

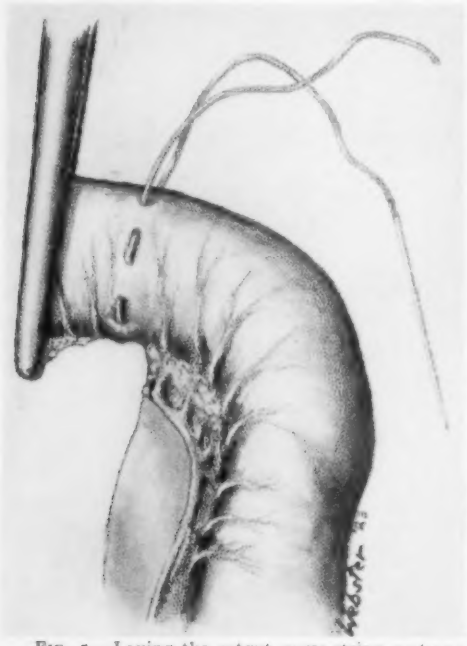

FIG. 5.—Laying the catgut purse-string suture about one of the loops. Six or more basting stitches are taken parallel to the clamp and at a sufficient distance for the subsequent closing-off of the bowel.

The Instrument.—The writer's instrument, shown in Figs. 1, 2, and 3, consists of (1) a cylindrical steel needle with a round eye at one end for the ligature, (2) a tubular knife of two pieces joined by threads, and (3) a tubular thumb-cap with a thumb-screw at one side. The needle is inserted in the tubular knife and held at its upper end by the thumb-cap with the thumb-screw acting as a vise. The

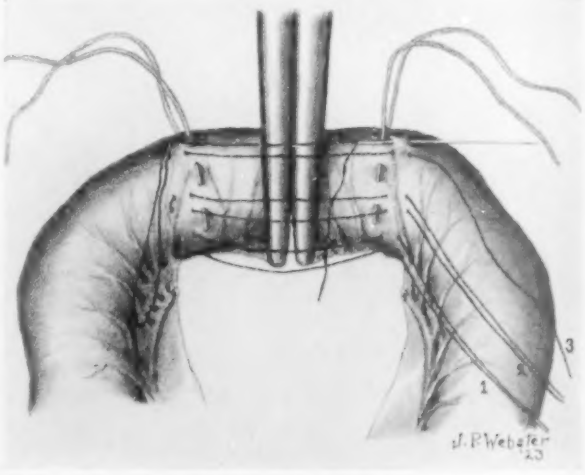

FIG. 6.—Laying the mattress sutures. In the dog's intestines these are taken about 2 mm. away from the purse-string sutures. No. 00 tanned catgut on "welded" needles gave better results than the silk sutures shown here.

knife is revolved and passes down over the eye of the needle. The occluding ligature is thus divided in two places by the cutting edge with the steady, smooth, sliding action of a razor and without requiring any tension on the suture material.

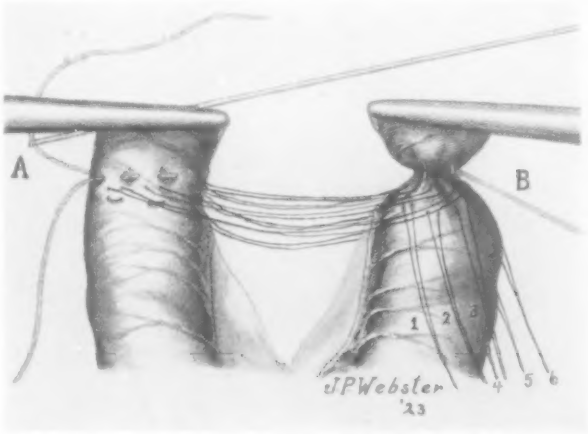

FIG. 7.—A. Threading the cylindrical needle on the purse-string suture. B. The suture tied and cut. Clamping the ends of each mattress suture serves to keep them unentangled.

Here, then, was the solution to the problem of cutting the ligatures with which the bowel ends were tied off, for the precision and uniformity with which the sharp edge of the revolving knife invariably cut the catgut proved that it could be used for this purpose with entire satisfaction. Nevertheless, it required experimentation to evolve an operation which would be consistently safe and which would give ideal results.

During 1922, this instrument was used in a series of preliminary experiments wherein the steps described in Series A were followed. The method had several defects which were eradicated in Series B and D.

FIG. 8.—The bowel and mattress sutures are being protected with a saline gauze sponge and the bowel is being cut away with a cautery beyond the purse-string suture.

Series A.—The loop of intestine to be excised was doubly ligated at each end, and, before being tied the outer ligatures of catgut were threaded through the eye of each needle (Fig. 2 F). After dividing the bowel aseptically between each pair of ligatures, silk sutures were laid joining the two closed ends. Several types of these approximating sutures — continuous, interrupted, and mattress—were tried out. These sutures were taken as near as possible to the occluding ligatures to reduce the size of the inturned walls forming the diaphragm, and all were tied except the

suture about the needles at the antimesenteric border. The line of sutures and of division of the bowel was at right angles to the long axis of the intestine.

The tubular knives were applied over the needles and the ligatures were released by revolving the knives. The last suture was tied and the mesenteric rent was closed. No attempt was made during operation to reëstablish the lumen but peristalsis was relied upon to do this.

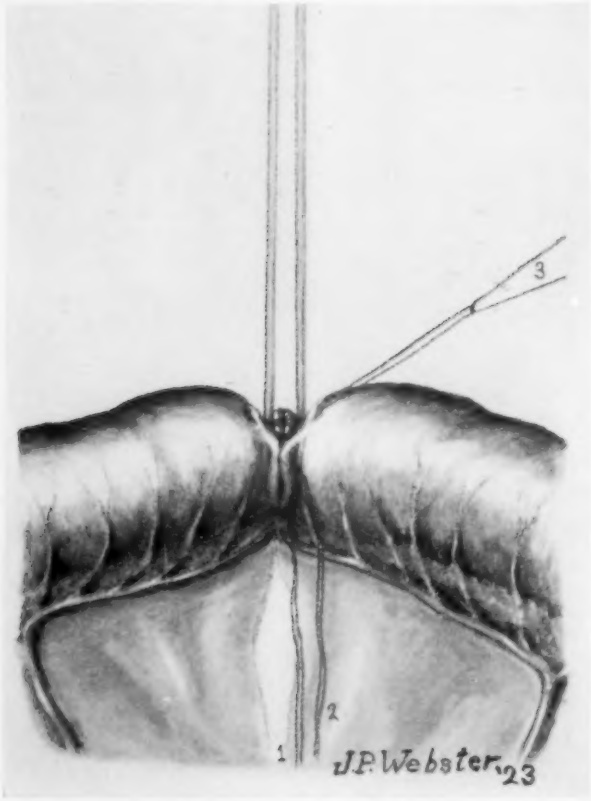

FIG. 9.—The closed ends are abutted and the first mattress sutures are being tied.

The admirable cutting quality of the knives was clearly demonstrated, but the results of the operations were so disappointing in regard to mortality that no preliminary report of the instrument was considered at that time. Several dogs were allowed to live for over two months. However, there was a total mortality of 47 per cent. with a mortality of 40 per cent. directly attributable to the operation. Several other dogs which were sacrificed showed some dilatation proximal to the anastomoses or almost complete blocking of the lumen. Food, hair, bones and other detritus were frequently found proximal to the line of union. In one dog a spicule of bone had pierced the bowel wall and had entered the peritoneal cavity. Complete or partial obstruction, local or general peritonitis, and leakage about the anastomosis were often found. Dense adhesions were the rule. Clinically there were frequent signs of temporary obstruction and several dogs had bloody stools.

Conclusions drawn from this series were:

1. The instrument was always efficient.

2. The operation as performed in this series was extremely dangerous.

3. There was difficulty in tying around the intestine two ligatures which would be parallel, close together, and not endangered when the bowel between them was divided.

4. It was difficult to prevent intestinal contents from being retained under considerable pressure between the two ligatures. When the bowel was severed at this point there was great danger of contamination, but this was lessened when dividing with a cautery instead of using a knife and carbolizing.

5. A simple catgut ligature tied about the bowel would often slip over the stump when the tissue beyond the ligature was cut very short.

6. If the sutures were placed without the aid of clamps subsequent to the ligation and division of the bowel, the intestine was traumatized and suturing was difficult.

7. Continuous sutures in this type of operation were dangerous. If they were taken close to the ligatures and tied tightly they would not permit the bowel at this point to dilate and obstruction might occur, while there was a possibility of leakage if they were tied loosely. If they were placed at some distance from the ligatures, the inturn left was too long and tended to cause obstruction.

8. After ligating the bowel, sutures taken adjacent to the ligatures frequently included infolded portions of the wall and thus prevented smooth approximation.

9. With the bowel cut at right angles to the long axis, sutures taken near the mesentery often impaired the blood supply at the antimesenteric border, causing necrosis and adhesions.

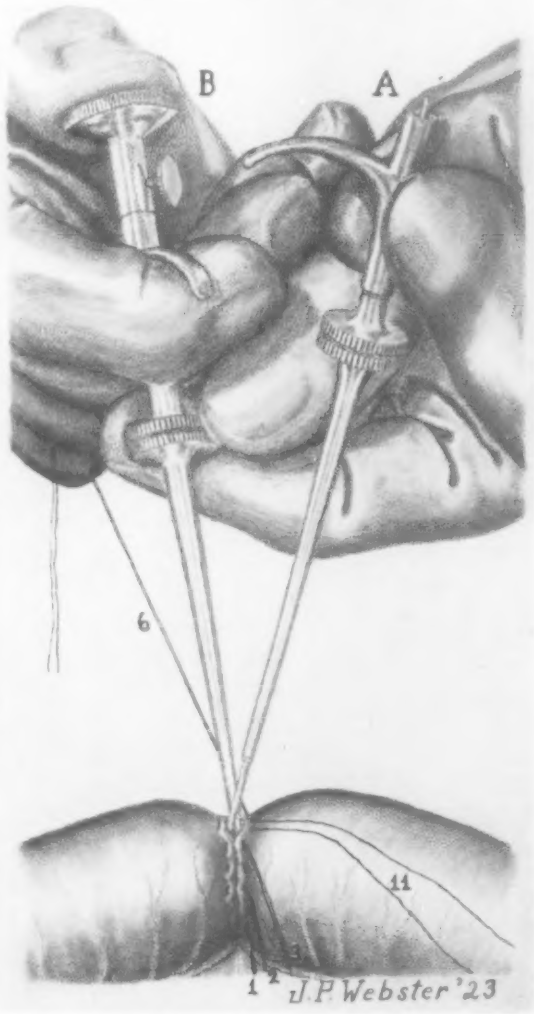

FIG. 10.—With all the mattress sutures tied except that (No. 11) about the needles, the knife (A) is being placed over the needle. B, Holding the instrument ready for cutting by revolving the knurled wheel.

The Operation.—Consideration of the unsatisfactory results obtained in Series A led to modifications in technic, resulting in the following operation, which has given uniformly satisfactory results:

After division of the vessels the mesentery is cut and is stripped away from the bowel on either side so that for a distance of about 1 cm. there is no mesentery to be infolded during the subsequent suturing. About the same distance beyond the denuded area a Kocher or Ochsner clamp is placed tightly on the bowel at a slightly oblique angle. The optimum is about 65 to 70 degrees from the entero-mesenteric line. After stripping the bowel to push aside the intestinal contents a second clamp is placed on the loop side parallel to the first clamp and as closely as possible to it without tearing the intervening tissue (Fig. 4 A). The other end of the

segment to be excised is doubly clamped in a similar manner and the bowel is aseptically severed between each pair of clamps by burning with a cautery along the outer clamps (Fig. 4 B).

Starting at the antimesenteric border of each bowel end, a purse-string suture of No. 1 catgut on a "welded" needle is laid about the bowel parallel to and about 1 cm. distant from the clamp (Fig. 5), the ends of the suture being left untied. Six or more basting stitches should be taken in the wall with this suture passing down to the submucosa.

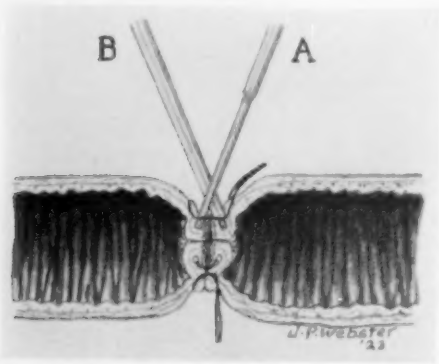

FIG. 11.—Sagittal section through bowel at stage depicted in Fig. 10. The knife (A) being placed and (B) in position for cutting. The close proximity of the mattress sutures to the purse-string sutures makes possible the subsequent opening of the lumen. Compare with Fig. 13.

The cut ends are brought together (Fig. 6) and, picking up the submucosa, three or four Halsted mattress sutures of No. 00 tanned catgut on "welded" needles are laid on each side of the bowel. These are placed about 2 mm. from the outer borders of the catgut purse-string sutures. The free ends of each mattress suture may be temporarily clamped.

The cut ends are now separated, with the loops of bowel parallel, and the needle portion of each instrument is threaded with one of the free ends of a catgut purse-string suture (Fig. 7 A). The bowel contents is stripped back and these sutures are tied (Fig. 7 B). To prevent cutting the ligatures, care should be taken to hold the needles at right angles and to tie the knots a short distance from them.

A saline sponge is clamped about each bowel (Fig. 8) to avoid burning the tissues and the mattress sutures. With a cautery the bowel ends are carefully cut away leaving stumps extending 2 to 3 mm. beyond the purse-string sutures and the mucosa is rendered aseptic by further cauterization.

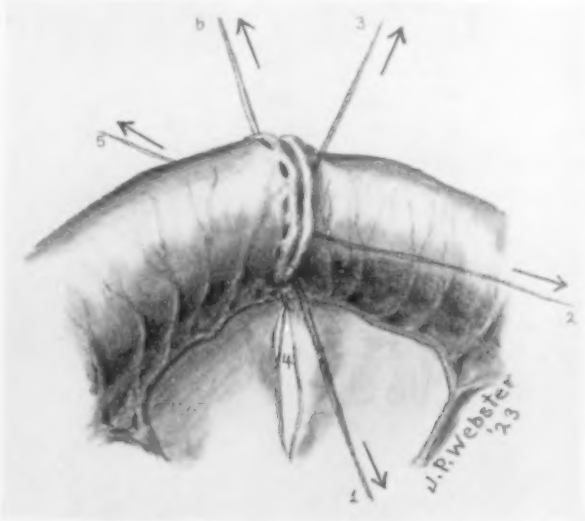

FIG. 12.—Opening the lumen by pulling outward radially on the mattress sutures.

The closed bowel ends are abutted and the mattress sutures are tied but not cut, the needle portion of the instrument projecting from the antimesenteric border (Fig. 9). Intermediate Halsted mattress sutures are placed between each of the first mattress sutures, the long ends of the latter being used to facilitate suturing, and the needle dipping down each time to pick up the tissue of the inturned walls. All sutures are tied except the one laid about the needles at the free border (Fig. 10, Suture No. 11).

The needles are sheathed with the tubular knives (Fig. 10 A) and are held fast by turning down the thumb-screws. The bowel is held suspended by the long ends of the

mattress sutures on either side of the needles (Fig. 10, Sutures 3 and 6), and both tubular knives are revolved (Fig. 10 B) so as to cut the purse-string sutures simultaneously. The instruments are withdrawn and the last mattress suture is tied. By pulling outward radially on the long ends of the mattress sutures (Fig. 12), the double diaphragm is opened up and the lumen is reëstablished (Fig. 13). A ring may now be felt similar to that at the pylorus. The operation is completed by closing the rent in the mesentery (Fig. 14).

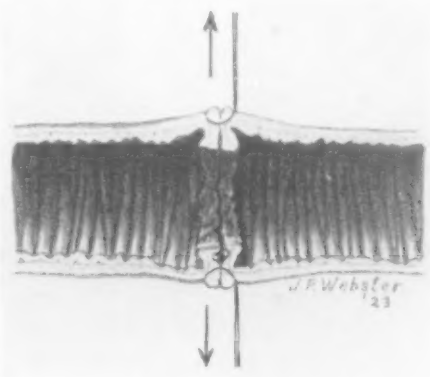

FIG. 13.—Section through anastomosis at stage shown in Fig. 12. The lumen reëstablished.

Series B.—In this series twenty-eight consecutive operations were performed on seventeen dogs using the type of operation just described but employing fine silk sutures, or occasionally No. 00 plain catgut on curved needles, instead of the No. 00 tanned catgut on "welded" needles. The dogs were sacrificed or the anastomoses were removed by operation from 0 hours to forty-four days after operation.

Of the twenty-eight operations, three were performed on the large bowel. These included an ileo-colostomy (dog sacrificed on the ninth day), a colo-colostomy at the transverse colon (dog sacrificed on the twenty-first day) and another at the pelvic colon (dog sacrificed on the twenty-ninth day). Three of the dogs with operations on the small bowel died but no death could be attributed to the fault of the operation. Two of these with satisfactory anastomoses died from pneumonia, while the third died on the twenty-first day with an intussusception well below the anastomosis. The lumen at the line of suture in this case was of normal size and there was no diaphragm present (Fig. 15).

The specimens frequently had no adhesions and when present they were usually small. There was a marked difference between the clinical picture presented by the dogs of Series A and those of Series B. The dogs in the latter series showed no signs of obstruction; they made normal convalescence, and twenty-four hours after operation usually ate solid food of millet mush, meat and bones. In practically all cases brown semi-formed or formed stools were passed the first day after operation. The dog with the ileo-colostomy and the one with the colo-colostomy of the transverse colon passed formed stools twenty-four hours after operation, while that with the colo-colostomy of the descending colon passed a formed stool within forty-eight hours.

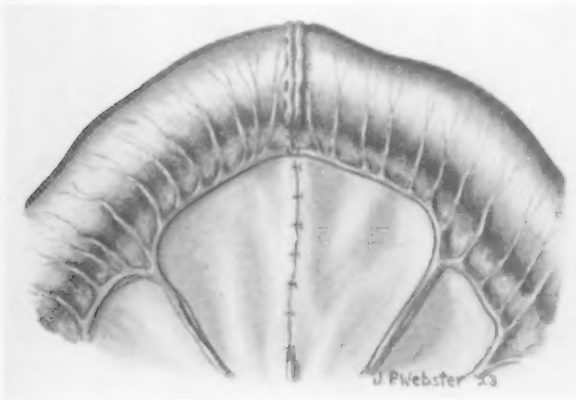

FIG. 14.—The anastomosis completed.

Bacteriological examination of the sutures showed that it was possible to perform this operation with no contamination from the bowel contents and also cultures taken from the deepest portions of the cauterized stumps showed no growth.

Hydrostatic experiments made on specimens removed immediately after operation,

or with the blood supply still intact in the living anæsthetized dog, showed that the line of union would stand a pressure of over 220 mm. Hg. (four pounds. per square inch) without leaking. As a routine procedure the specimens recovered were distended with the fixing fluid at 50 to 100 mm. Hg. pressure (one to two pounds) without showing any leakage. One newly-made anastomosis was excised and lay in 10 per cent. formalin for nearly an hour while a second anastomosis was being performed. The first specimen showed no leak when distended to a pressure of 600 mm. Hg. (nearly twelve pounds per square inch). At 620 mm. Hg. pressure the serous and muscular coats split everywhere except at the suture line leaving the submucosa intact (Fig. 16). It was thought that the ability to stand such great pressure was due to the formalin as these figures are considerably higher than those of J. E. McWorter, Stout and Lieb.[7] Muller,[8] however, showed that the unfixed ileum of the cat will withstand even higher pressures without entirely rupturing, and that the mucosa is the last to burst.

FIG. 15.—Dog 48. Op. 146. Section through ileo-ileostomy by the writer's technic. (H and E X 10.) The dog died on the 21st day from intussusception well below the anastomosis. Note the absence of obstructing diaphragm and the rapidity of repair.

One anastomosis was made twenty-four hours after the bowel had become strangulated, engorged and dilated by tying off a loop with tape according to McWhorter's technic.[7] After excising the strangulated loop, no difficulty was encountered in suturing together the two loops of different dimensions.

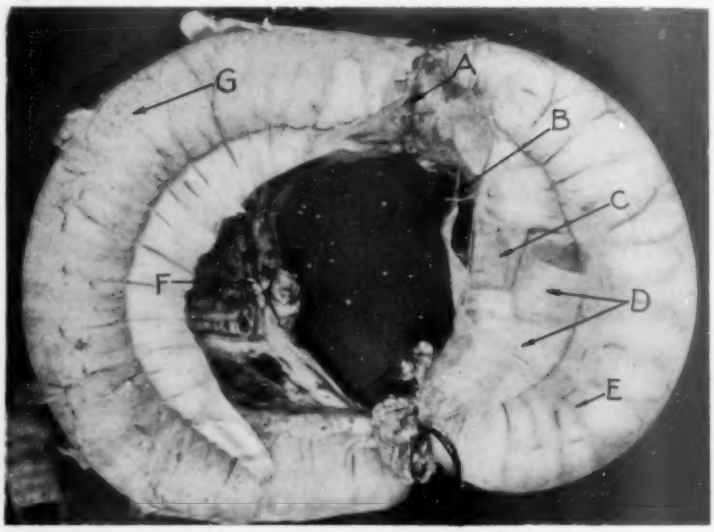

FIG. 16.—Specimen removed immediately after the writer's anastomosis had been performed on the ileum. This shows the outer coats ruptured after distention with 620 mm. Hg. pressure. A. Anastomosis. B. Serosa. C. Longitudinal muscle fibres. D. Circular muscle fibres. E. Intact submucosa. F. Mesentery. G. Peyer's patch.

The conclusions from this series were:

1. This operation could be performed on the large and the small bowel and also between the two without danger from hemorrhage, infection, or obstruction, and adhesion formation was also greatly lessened.

2. It was possible to perform the anastomoses aseptically.

3. The purse-string suture gave less chance for slipping than when a

simple ligature was tied about the bowel and besides the stumps could be left shorter.

4. Sutures taken at the mesenteric border did not impair the blood supply at the opposite border if the bowel was cut away slightly obliquely from the entero-mesenteric line. The lumen was also enlarged by this procedure.

5. The mattress sutures could be laid evenly, readily and close to the purse-string sutures if placed before these were tied.

6. A single row of mattress sutures laid in this manner, placed near the purse-string sutures, produced a small diaphragm yet gave sufficiently broad approximation of serous surfaces to prevent leakage.

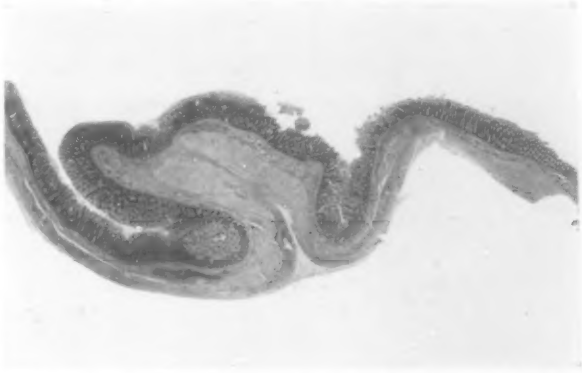

FIG. 17.—Dog 73. Op. 273. Section through anastomosis by Bidgood's method of colo-colostomy (H and E X 5), 63 days after operation. Note the large diaphragm.

7. The suture line would withstand much more internal pressure without leakage than could possibly be present under conditions existing in vivo.

8. The double diaphragm could be satisfactorily opened up so as to reëstablish the lumen at the time of the operation.

FIG. 18.—Dog 79. Op. 280. Section through colostomy performed by the writer's technic. (H and E X 10.) The dog died on the 68th day. Note the complete unfolding of the inturn.

9. In Series B there was less trauma to the bowel and less difficulty in suturing than in Series A.

After the revolving tubular knife had been devised, several investigators [9, 10, 11] reported other methods for releasing the ligatures occluding the bowel ends. They approached more and more closely the principle upon which the writer's instrument was based.† Finally after over sixty operations had been performed with this instrument, an article by Bidgood [14] appeared in which he modified Halsted's operation. He used a hollow needle,

† Burket and McClure [12] and Foley [13] also published methods whereby the bulkhead suture was used in conjunction with instruments for cutting away the bowel walls internally.

through which a purse-string suture was threaded and subsequently cut by drawing a small knife that lay between the needle end and the eye. Like Halsted, he left a broad ring of inturned bowel wall between the purse-string and the mattress sutures. After reviewing Halsted's operation and describing his own instrument, Bidgood reported the results of his experiments on the colon in this single sentence: "Six dogs have been operated on by this method without the death of any of them, and in the last case there was a solid bowel

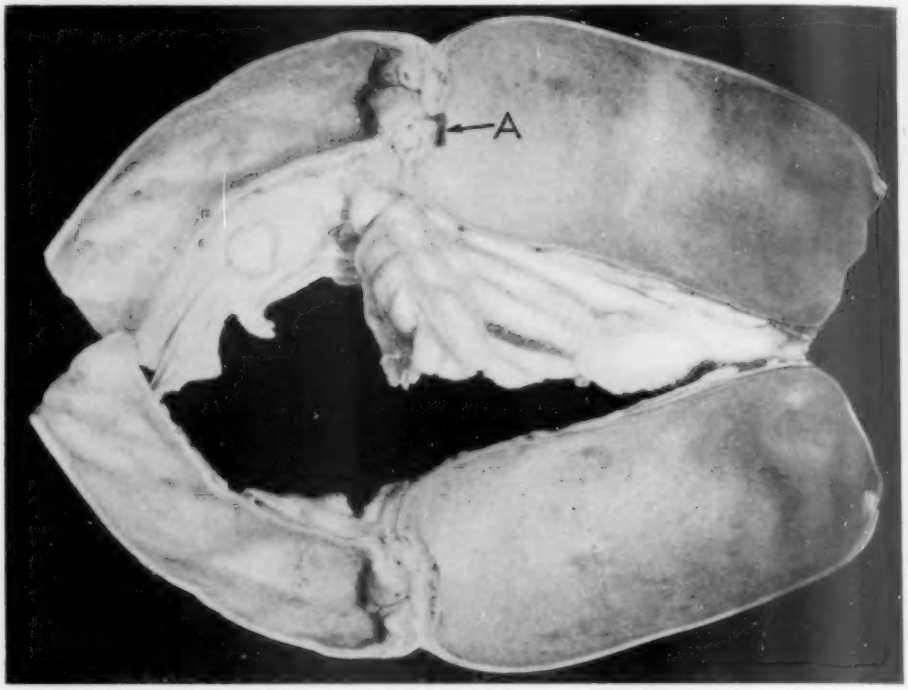

FIG. 19.—Dog 76. Op. 276. Sagittal section through bowel with Bidgood's type of colo-colostomy. The dog died on the 15th day. Note the distention of the proximal loop and the large diaphragm. A. Silk purse-string suture.

movement in thirty-six hours, which showed that the obstruction had been effectively removed." He said in conclusion: "This procedure can be carried out in any part of the large or small intestine."

Bidgood's instrument apparently has several disadvantages: (1) It is heavy and cumbersome during the period of suturing; (2) it is difficult to sharpen; (3) it cannot be sharpened repeatedly; and (4) the ligature, in order to be divided by the knife, must be under tension.

Lee [15] also described an instrument simpler in construction and similar to Bidgood's except that the knife was inserted in the hollow needle and was pressed down instead of being brought up. This instrument also depended upon the tension of the ligature in cutting.

Lee gave no clinical results other than presenting and describing photographs of two sections taken from anastomoses in the colon thirty days after operation.

While both Bidgood's and Lee's instruments could be used on the small as well as on the large bowel, yet it seemed probable that their type of operation, because of the large diaphragm formed, would be unsafe for use on the small intestine, especially as the occluding ligatures were merely released without reëstablishing the lumen.‡ Accordingly to determine the effect of leaving long inturned bowel walls at the line of union, the author carried out another series of experiments in which the steps of Bidgood's modification of

FIG. 20.—Dog 71. Op. 271. Specimen of anastomosis 104 days after ileo-ileostomy using the writer's technic. This section was excised at operation (Bidgood's type) and the dog died 3 days later. Compare with Fig. 22.

Halsted's operation were followed with the exception that the writer's instrument was used instead of Bidgood's.

This particular operation was chosen merely as an example of several methods advocated for blind-end intestinal suture, in which the occluding ligatures are tied before laying the mattress sutures and in which a large amount of inturn is left between the two.

Series C.—Three anastomoses were performed on the descending colon and three on the ileum using Bidgood's technic. The first dog with a colo-colostomy died on the sixty-third day from other causes. At autopsy the bowel proximal to the anastomosis was somewhat dilated. While the lumen at the suture line admitted the tip of the little finger, the inturned walls formed a considerable diaphragm (Fig. 17). One of the

‡ Halsted in his operation made sure of opening the lumen by passing a knife and bougie through the large diaphragm in the colon.

silk purse-string sutures which had been cut at operation was still embedded in the flange and hung into the lumen.§

The second dog with Bidgood's type of colo-colostomy died on the fifteenth day. Autopsy showed marked consolidation of both lungs. The colon was free from adhesions, but it was dilated and hyperæmic down to the anastomosis. Below this the bowel was contracted and small. Only with great difficulty could fluid be forced through the anastomosis. On opening the intestine a large diaphragm was found which practically shut off the colon (Fig. 19). Halsted had suggested cauterizing the stumps and trimming away the excess of tissue with scissors. Such a procedure had been followed in this operation and cultures taken at the time showed no growth from the upper stump but B. coli was grown from the lower end.

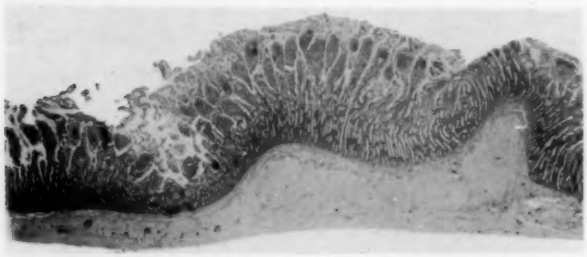

FIG. 21.—Dog 71. Op. 271. Section through anastomosis 104 days after ileo-ileostomy by the writer's method. (H and E X 10.) The line of union is between the mucosal folds with a suture shown at the right.

The third dog was sacrificed immediately after operation. The specimen showed a large diaphragm through which it was very difficult to pass fluid. Nearly all of the diaphragm lay between the purse-string and the mattress sutures.

The first dog with Bidgood's type of ileo-ileostomy had had an anastomosis performed by the writer's method (Dog 71, Op. 271) 104 days previously (Figs. 20 and 21), and he was in excellent condition at the time of the second operation (Dog 71, Op. 282). The loop containing the first anastomosis was excised. In joining the closed bowel ends the mattress sutures were taken as far away from the purse-string stures as Bidgood and Halsted

FIG. 22.—Dog 71 seen at autopsy 3 days after Bidgood's method of anastomosis had been performed (Op. 282) with the excision of the anastomosis shown in Figs. 20 and 21. A. Anastomosis covered by omental adhesions. B. Proximal bowel. C. Contracted distal bowel. D. Omentum released and turned back.

§ In contrast to this was a similar operation by the writer's technic performed about the same time. This dog passed a large formed stool within forty-eight hours after operation and on the fourth day had a huge stool 1½ inches in diameter. His convalescence was normal in every way. He died on the sixty-eighth day from other causes and the anastomosis was found to be in excellent condition without any adhesions and without any projecting diaphragm (Fig. 18).

advised. Marked peristaltic patterns were present on the second day and the dog died the following day. Autopsy revealed a typical picture of acute intestinal obstruction (Figs. 22 and 23) and no fluid could be forced through the diaphragm.

In the second ileo-ileostomy (Dog 80, Op. 283) the mattress sutures were taken somewhat nearer the purse-string sutures than either Halsted or Bidgood advised. Forty-eight hours after operation the dog was found dying of acute intestinal obstruction and an attempt was made to relieve the obstruction by excising the first anastomosis and performing another by the writer's method (Dog 80, Op. 285. See Series D). However, the dog died five hours later. At the second operation there was found very marked difference in size between the greatly dilated proximal loop and the tightly contracted distal loop (Figs. 24 and 25), and no fluid could be forced through the diaphragm. Despite the inequality in the size of the two bowel loops they were smoothly anastomosed by cutting the larger bowel transversely and the smaller at an angle of 45 degrees and by taking the stitches of the mattress sutures farther apart in the former than in the latter.

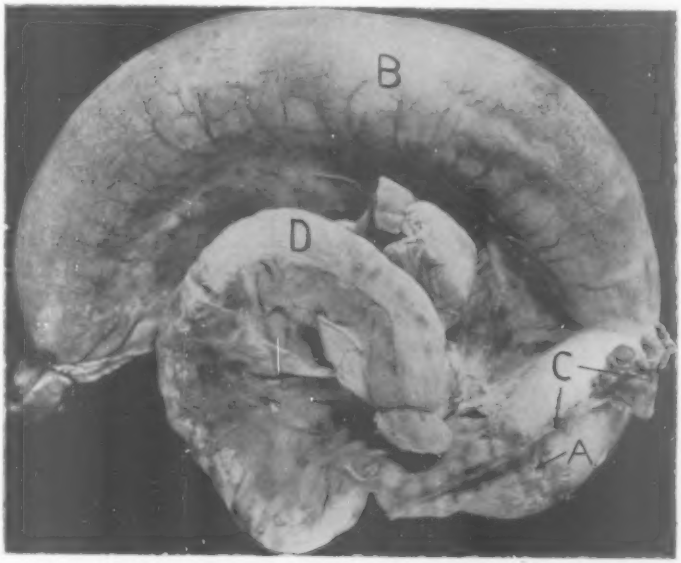

FIG. 23.—Dog 71. Op. 282. Specimen of anastomosis. The dog died 3 days after ileo-ileostomy by Bidgood's method. A. Anastomosis B. Dilated proximal bowel. C. Adhesions. D. Contracted distal bowel.

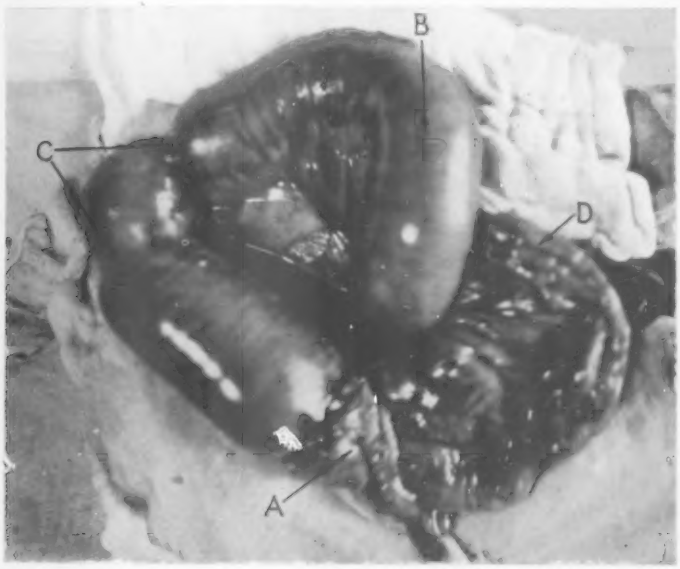

FIG. 24.—Dog 80. Op. 283. Specimen of anastomosis performed 2 days previously by Bidgood's technic and seen at second operation (No. 285. See Series D.) A. Anastomosis covered by adhesions. B. Dilated proximal loop. C. Contracted distal loop. The specimen was excised and the loops A and D were accurately sutured together by the writer's method. The dog failed to recover and died five hours later.

In the third ileo-ileostomy (Dog 83, Op. 287) Bidgood's technic was fol-

lowed, but the mattress sutures were placed as near as possible to the purse-string sutures. This was essentially the same operation as that performed in Series A and the same difficulties of suturing were encountered. On the second day the anastomosis was excised and another was made by the writer's technic (Dog 83, Op. 288). As a result of the first operation no dilatation or constriction was found and a sufficiently large lumen permitted the free passage of intestinal contents.

The conclusions from Series C were:

1. End-to-end anastomoses with large unopened double diaphragms were

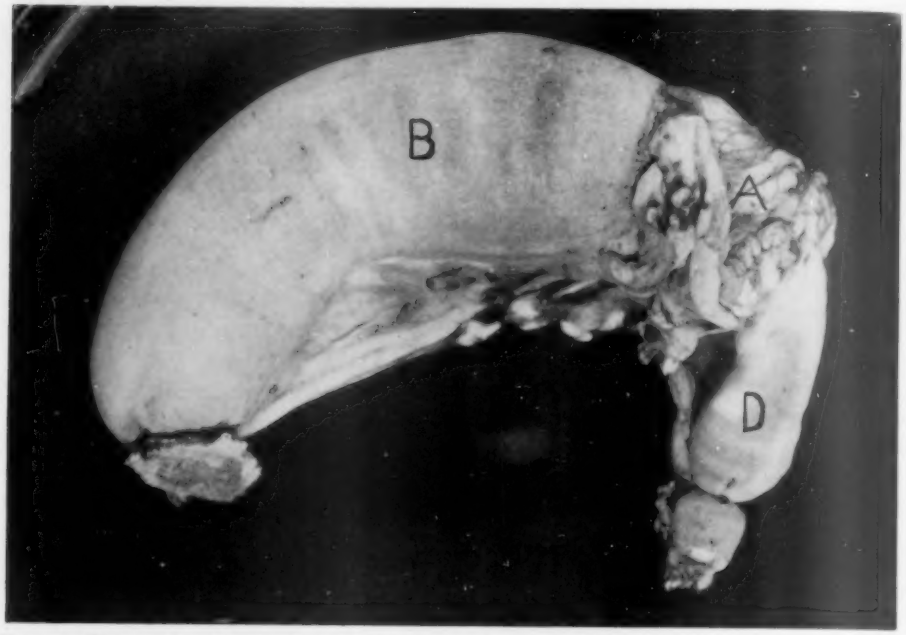

FIG. 25.—Dog 80. Op. 283. Specimen excised 2 days after Bidgood's type of ileo-ileostomy. A. Anastomosis. B. Dilated proximal bowel. D. Small distal loop.

extremely dangerous when performed on the small intestine, and the inturned walls in the colon were slow to straighten out.

2. Silk purse-string sutures were less satisfactory than those of catgut because they were retained for a much longer time.

3. It was unsafe to trim away with scissors the excess of cauterized stumps beyond the purse-string sutures.

4. A bowel of small dimensions could be approximated and sutured evenly to a much larger bowel by the writer's technic.

As the criticism might be made that the twenty-eight consecutive operations by the writer's method in Series B were not conclusive because the specimens were obtained at periods ranging from immediately after the operation until the forty-fourth day, it was decided in the autumn of 1923 to perform another series of consecutive operations, allowing the dogs to live for at least a month before removing the specimens. (See Table I.) In previous anastomoses silk mattress sutures had occasionally been found after several weeks still attached to the bowel wall and extending into the lumen.

For this reason No. 00 tanned catgut on "welded" needles was used for the mattress sutures.

Series D consisted of nine operations on seven dogs. One of these operations was performed on a dog dying of acute intestinal obstruction caused by Bidgood's anastomosis (Dog 80, Op. 283) made two days previously. Because of the dog's condition and almost immediate death after operation, the case should not be counted in this series.

All anastomoses were performed after excision of portions of ileum. Three of these operations were incidental to experiments on closure of enterostomy loops. Full diet was given the day after operation and there were no symptoms of even partial obstruction at any time.

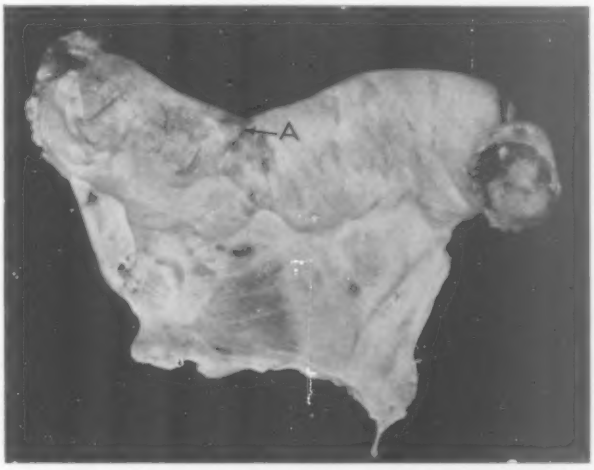

FIG. 26.—Dog 81. Op. 284. Specimen obtained 105 days after ileo-ileostomy by the writer's technic. Excised at Op. 294. No. 00 tanned catgut mattress sutures were used.

One dog (No. 82, Op. 286) died on the forty-first day from marked distemper. As the bowel was found to be entirely free from adhesions and as there was a full-sized lumen with no projecting diaphragm (Fig. 28), his death could in no way be attributed to the operation. Specimens were obtained from the other dogs, by operating or after sacrificing, at intervals of from 33 to 107 days. With one exception there were absolutely no adhesions about the anastomoses. This specimen (Dog 87, Op. 296. Figs. 37 and 38) was found on the outskirts of a peritoneal abscess localized on the other side of the abdomen and caused by an operation to which the anastomosis was incidental.

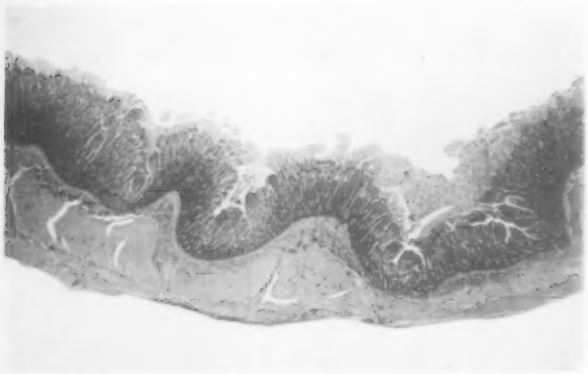

FIG. 27.—Dog 81. Op. 284. Section through anastomosis 105 days after ileo-ileostomy by the writer's method. (H and E X 10.) It is difficult to determine the exact position of the line of union. The inturned walls have completely disappeared and are merged with mucosal folds of normal size.

In these specimens there was no constriction in the line of suture, no projection of catgut into the lumen, hardly a trace of the inturned walls, and it was often difficult to determine the exact line of union by examining the cut edges at the site of anastomosis. All of the specimens were most remarkable for the rapidity and perfection of the anatomical and physiological repair.

Conclusions from Series D were:

1. When tanned catgut was used the sutures did not project into the lumen, and adhesion formation was less than when silk was used.

2. The operation caused no late complications and gave uniformly good results.

TABLE I.

Series D. Operations by the Writer's Technic. Mattress Sutures of No. 00 Tanned Catgut on "Welded" Needles.

	Series No.	Dog No.	Operation No.	Individual Op. No.	Age of specimen	Specimen obtained by	Cause of death	Dilatation	Constriction	Diaphragm	Adhesions	Remarks.
	1	81	284	I	105 days	Operation	.....	0	0	0	0	
(B)	2	80	285	II	5 hours	Death	Intestinal obstruction from Bidgood's operation 2 days previously					Operation not counted in Series D.
	3	82	286	I	41 days	Death	Marked distemper	0	0	0	0	
(B)	4	83	288	II	107 days	Operation	.....	0	0	0	0	
	5	84	289	I	69 days	Operation	.....	0	0	0	0	
(A)	6	85	291	II	89 days	Operation	.....	0	0	0	0	
	7	84	292	II	72 days	Operation	.....	0	0	0	0	
(A)	8	81	294	II	82 days	Sacrificing	Ether intoxication	0	0	0	0	
(A)	9	87	295	I	33 days	Sacrificing	Ether intoxication	0	0	0	+	Adhesions caused by enterostomy experiment.

Discrepancy in consecutiveness of dog and operation numbers is explained by other experiments on the closure of enterostomy loops. (A) Anastomosis is incidental to enterostomy experiments. (B) See Series C.

OPERATION ON MAN

After the instrument had been used eighty-six times on dogs and after the safety of the operation had been established, an anastomosis was performed on a man in conjunction with the closure of loops of ileum that had been left open to relieve a strangulated hernia. Following the anastomosis there was neither abdominal distention nor any symptoms suggesting obstruction. On the second day the patient passed yellow fecal material by the normal route and on the fourth and following days he had normal, formed, yellowish-brown stools. He was eating full diet by the seventh day after operation without ill results and made an uneventful recovery. A further report will be given of the case after several months have elapsed.

Discussion.—While many attempts have been made with varying success to devise a means for releasing the ligatures or purse-string sutures that

occlude the bowel in blind-end circular suture, the instrument here described seems to meet all the desired requirements. The sharp edge of the knife invariably cuts the catgut with a smooth, even gliding motion and does not penetrate the bowel wall. It requires no tension on the sutures and no countertraction is needed. The weight of the slender needles does not pull on the purse-string sutures and the heavier parts of the instrument are applied only at the time of cutting. Needless to say, one should not use the instrument as an aid to suturing. The cutting edge can be sharpened readily and repeatedly without impairing its usefulness. The instrument is under perfect control, as it is equipped with very convenient grips. Because of its simple parts and the ease with which it can be completely dissembled, the instrument can be quickly cleaned and oiled. There are no parts to get out of order and the instrument is constructed on well-known mechanical principles.

FIG. 28.—Dog 82. Op. 286. Section through anastomosis 41 days after ileo-ileostomy by the writer's technic. (H and E X 6.) Note the very early straightening of the inturn which is already lower than the normal mucosal fold at the left.

Whereas originality is claimed for the instrument, the operation is largely the result of the ideas and labors of several investigators. Walker [16] used the blind-end suture in 1908, and Halsted stimulated interest in this type of anastomosis by his many experiments. It would be impossible to use the method described here if Halsted had not established the necessity for utilizing the submucous coat to give strength to intestinal sutures. G. L. McWhorter [17] and Lockhart Mummery,[18] in the open type of end-to-end anastomosis, showed that the great danger of poor blood supply at the free border could be overcome and that the lumen could be enlarged by cutting the bowel obliquely from the mesentery to the free border. Rostowzew [19] advised pulling outward on the sutures which approximate the bowel ends in order to open up the diaphragm.

FIG. 29.—Dog 83. Op. 288. Section through anastomosis 107 days after the writer's type of ileo-ileostomy. (H and E X 10.) The height of the mucosa and thickness of the wall at the suture line is equal to that in adjacent parts.

However, the problem could not be solved by merely combining these methods, for there were so many factors in this type of anastomosis to be studied and so many difficulties to be overcome, that it was impossible to arrive at a correct solution before performing a large number of experiments.

In order to cut the bowel obliquely to prevent impairment of blood supply in blind-end circular suture, it is necessary to use a purse-string suture which picks up the bowel wall with the stitches so that the ligature will not slip over the cut end of the bowel. While Halsted used a basting stitch for

FIG. 30.—Dog 84. Op. 289. Specimen of ileo-ileostomy by the writer's method removed 69 days after operation and distended with a pressure of 100 mm. Hg. pressure. This shows the complete absence of adhesions and the slight amount of angulation caused by cutting both ends at a slightly oblique angle.

closing off the bowel,[3] he placed his sutures and severed the bowel at right angles to the long axis. It is even more important to stitch around the bowel when suturing and cutting obliquely, and there should be a sufficient number of these stitches taken, particularly when there is distention and increased pressure from obstruction. Theoretically, it is not ideal to cut a large number of the circular muscle fibres, as peristalsis might be prevented at that point. This was one of the objections advanced against the use of lateral anastomosis.

It is obviously of the greatest advantage to overcome the danger of obstruction by reëstablishing the lumen at the suture line at the time of operation, and it is equally obvious that this cannot be done by pulling outward radially on the sutures if there is a large inturned wall. Even if it were possible to pull apart the closed edges of each bowel end, the diaphragm would immediately retract upon release and tend to block the lumen. This is one great reason for placing the approximating sutures close to the purse-string

sutures, for when so placed traction upon them reëstablishes the lumen completely and permanently. The second reason for wishing to narrow the distance between the purse-string and mattress sutures is to reduce the diaphragm so that there may not be obstruction from this source, and also that the bowel may straighten out at the earliest possible time consistent with safety and leave no projecting flange. Halsted says of this last[3]: "The more perfect the execution of any method of end-to-end anastomosis, the less reaction about the line of suture and the greater the rapidity of the unfolding of the inturn, of the complete restoration of the lumen of the bowel." It is believed that with the operation described in this paper there is less adhesion formation, quicker disappearance of the inturned wall, and more perfect anatomical and physiological restoration of the lumen than with any other method yet reported.

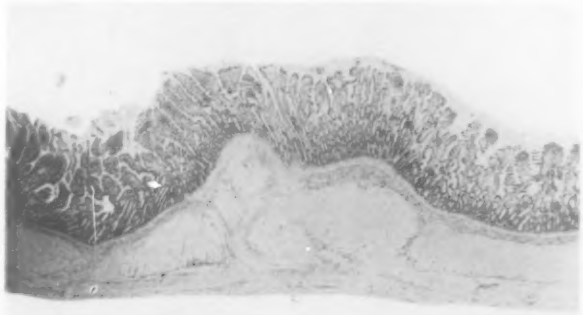

FIG. 31.—Dog 84. Op. 289. Section through anastomosis 69 days after ileo-ileostomy by the writer's technic. (H and E X 10.) No. 00 tanned catgut mattress sutures were used. The thickness of the wall at the suture line is only slightly greater than that of nearby mucosal folds which do not appear here.

The fact that the inturned walls can safely be reduced to such a small area of approximating serous surfaces seems to have escaped the notice of other investigators. Possibly this was due to the fact that it had only been tried with the open method where the factors of infection between the peritoneal surfaces and the lack of proper blood supply caused frequent failure. The safety of this step has been proved repeatedly on dogs and only once upon man, when only one row of mattress sutures was employed.

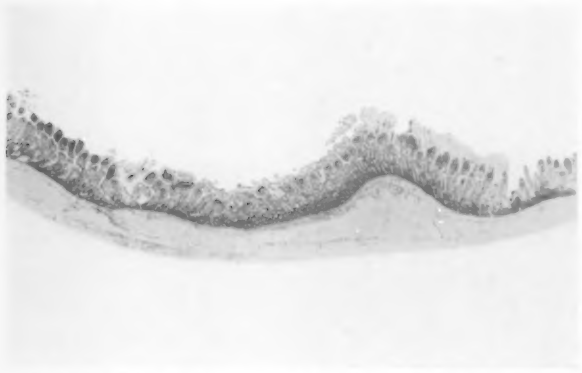

FIG. 32.—Dog 85. Op. 291. Section through ileo-ileostomy performed by the writer's technic 89 days previously. (H and E X 10.) The complete straightening out of the inturn has left a perfectly smooth wall equal in thickness to that on the right of a normal mucosal fold.

In order to place these sutures evenly and easily, at the desired proximity to the purse-string sutures, and without including portions of infolded walls, it is necessary to lay many of them before the occluding ligatures are tied. This means that there must be strands of suture material connecting the bowel

loops on either side of the segment to be excised. It also practically renders impossible the use of continuous approximating sutures and compels the previous excision of long intervening bowel loops. Connecting sutures might readily be bridged across a short length of diseased bowel and this procedure

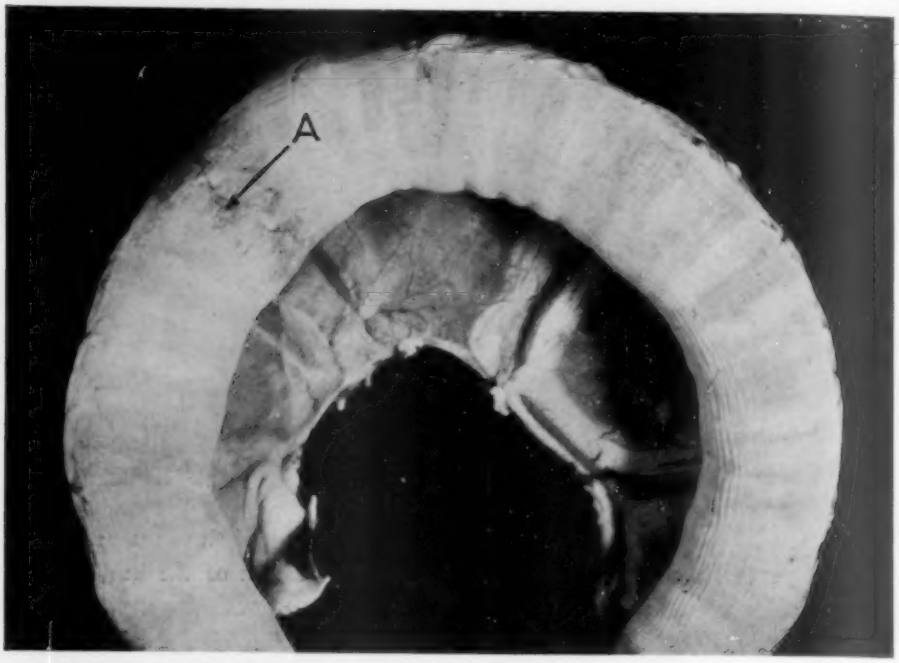

FIG. 33.—Dog 84. Op. 292. Specimen of ileo-ileostomy 72 days after excising the anastomosis made at Op. 289. Both operations were by the writer's method. (See Figs. 30 and 31.) A. Line of union. This shows the smooth even caliber of the bowel which is entirely free from adhesions.

might be advisable where every millimetre of bowel required for anastomosis must be preserved in order to approximate the cut ends without excessive tension. Unless bridged across, double cutting is necessary.

One could, of course, excise the diseased bowel by severing it between two strong clamps on either side, place the purse-string sutures close to the outer clamps, lay the approximating sutures just beyond, release the clamps and tie the purse-string sutures. However, it is difficult to take stitches close to compressing clamps and besides there is a possibility of contamination by opening the bowel ends when tying the occluding sutures after removal of the crushing clamps. This possibility is greater if the contents of the bowel is under abnormal pressure. Soiling might be prevented by the use of intestinal clamps, but in some locations they might be difficult to

FIG. 34.—Dog 84. Op. 292. Section through anastomosis 72 days after ileo-ileostomy by the writer's technic. (H and E X 7). There is a slight thickening of the wall which may be a mucosal fold.

apply, and it is better to do without them. Sabin [20] has shown that even when placed lightly in position these clamps cause changes in the bowel wall which can be detected microscopically. Should the purse-string sutures be placed farther away from the clamps to make the sewing easier, there would be a greater tendency for the ends to open, and an unnecessarily long and perhaps dangerous amount of inturn would be left to impede the flow of intestinal contents.

FIG. 35.—Dog 81. Op. 294. Specimen of anastomosis by the writer's method 82 days after ileo-ileostomy. Tanned catgut mattress sutures were used. Op. 284 was excised at this operation (see Figs. 26 and 27). The two adjacent loops were stripped of mucosa and submucosa aseptically and were left with the blood supply intact to the sero-muscular coats. In spite of all these procedures there was an entire absence of adhesions. A. Anastomosis.

Hence, there is left the alternative of placing the purse-string sutures far enough away from the clamps to be able to tie off the bowel completely and then of severing the intestine between the occluding sutures and the clamps. This adds unappreciably to the length of the operation and is the step here recommended.

It might be claimed that it is not ideal to cut the bowel ends obliquely and to join them so as to form an angle at the line of union. This is true to a certain extent, but it has been found experimentally that the blood supply about the anastomosis can be fully maintained when each bowel is cut at an angle of 20 to 25 degrees away from the perpendicular. When the ends are so united there is formed an angle of 140 to 130 degrees, which is not enough to cause any trouble. The safety of this procedure has been frequently demonstrated on dogs. It is undoubtedly much better to have no impairment of the blood supply and this moderate angulation than it is to cut at right angles and have poor circulation with resulting adhesions or necrosis at the free border of the intestine.

FIG. 36.—Dog 81. Op. 294. Section through ileo-ileostomy by the writer's technic 82 days after operation. (H and E X 7.) The wall is of normal thickness and contour. A catgut suture is seen at the left while another at the right has apparently entered the mucosa.

Following open operations on the bowel, one so often sees masses of adhesions between intestinal loops and between these and other structures

that it is amazing not to have more late complications. Intestinal obstruction results all too frequently, and it is especially dangerous to have these adhesions when the abdominal contents are deranged by pregnancy. Any operation which eliminates this possibility should preferably be employed if satisfactory in other respects. Halsted[1] said in 1891: "The success of any form of intestinal suture is inversely proportionate to the extent of the adhesions which result from the employment of the particular method," and again[2] in 1922: "The more perfect the operation the fewer the adhesions." Judging the operation presented here from this standpoint and from that of the complete and rapid restoration of the lumen, it would seem to be not far from the ideal type of anastomosis.

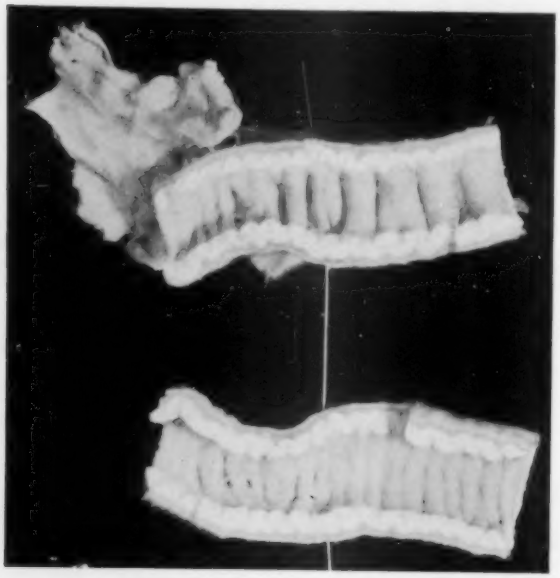

FIG. 37.—Dog 87. Op. 295. Sagittal section through the ileum 33 days after a long segment had been separated off to form blind enterostomy loops and the bowel anastomosed by the writer's method. The needles mark the line of union. The rapidity and perfection of the repair is noteworthy. No. 00 tanned catgut used for mattress sutures.

SUMMARY

1. The instrument has proved satisfactory in every way in 87 operations.

2. The operation is easily performed and can be safely employed between any portions of the intestinal tract.

3. In any method of aseptic end-to-end anastomosis that relies on the release of ligatures or purse-string sutures tied about the closed ends of abutted loops: (a) the approximating sutures should be taken close to the occluding sutures before the latter are tied; (b) the bowel ends should be cut slightly obliquely; and (c) the lumen should be opened at operation.

FIG. 38.—Dog 87. Op. 295. Section through anastomosis 33 days following ileo-ileostomy by the writer's technic. (H and E X 7.) This shows how far advanced the repair may be at the end of a month. There is little to show that a segment of bowel has been removed. The mucosa is of normal height, the inturn is no higher than neighboring folds, and the scar at the line of union is extremely slight.

4. With the use of silk mattress sutures and with the removal of specimens

from 0 hours to 44 days, 28 consecutive anastomoses have been performed on dogs without a death attributable to the operation and with very few adhesions.

5. With using tanned catgut and allowing the dogs to live from 33 to 107 days, there have been 8 consecutive anastomoses performed without a death from the operation and with no adhesions about the suture line as a result of operation.

6. The anastomosis was performed once on man with ideal results.

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ASEPTIC END-TO-END ANASTOMOSIS OF THE INTESTINE*

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Many methods for performing aseptic end-to-end anastomosis of the intestine have been described, and some of them have been used with success clinically, but the ideal operation has not been found. Eventually such an operation may be evolved and substituted for the open operations now in general use; it must be superior to the current methods, and technically infallible in the hands of the average operator. The requirements to be met in

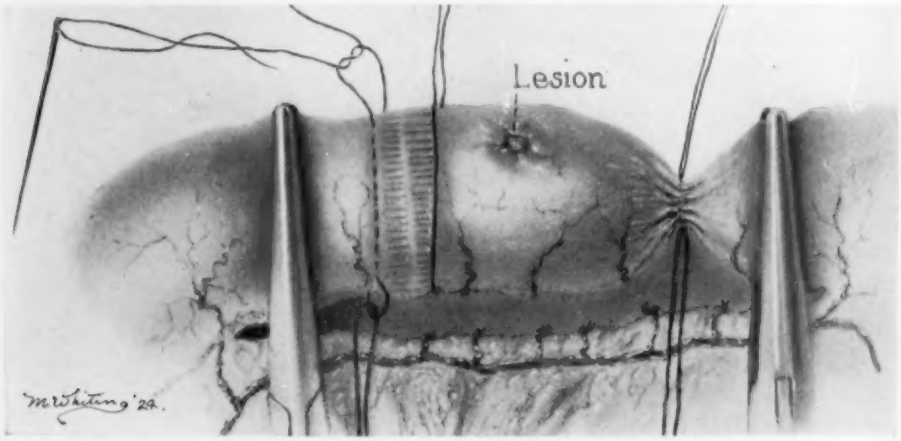

Fig. 1.—Position of clamps at six points (suture outlines position of four clamps) and purse-string suture under which is looped linen thread.

an aseptic anastomosis of the intestines are: asepsis, simplicity, complete hæmostasis, and avoidance of obstruction, temporary and permanent. The operation described here is submitted as a contribution toward the final solution of the problem. It has proved very satisfactory experimentally and seems to have met the foregoing requirements. The essential points of the operation are the making of two blind ends, invaginating them, then suturing them over a ball,† and the removal of the ball from the site of operation after the obstructed, invaginated ends have been opened.

Technic of Operation.—Strong Kocher forceps are applied to the intestine (Fig. 1), two at each end of the portion to be resected, and one at each end of the portion

* Work done in the Division of Experimental Surgery and Pathology.

† The ball is round and in our experiments has measured about 1.56 cm. in diameter. It is composed of very hard rubber of a woody consistency. It contains two straight canals of equal length, each having a diameter of about 1.56 mm. The entrances to these canals are 180 degrees apart. The exits are 90 degrees from the entrances and lie about 3.12 mm. apart, in a line which is perpendicular to the axis joining the two entrances. This line is parallel to the line of suture.

to be retained, about 1.25 cm. from the first forceps The intestine is freed of its blood supply as far as the forceps farthest from the lesion, and the mesentery is cut. The

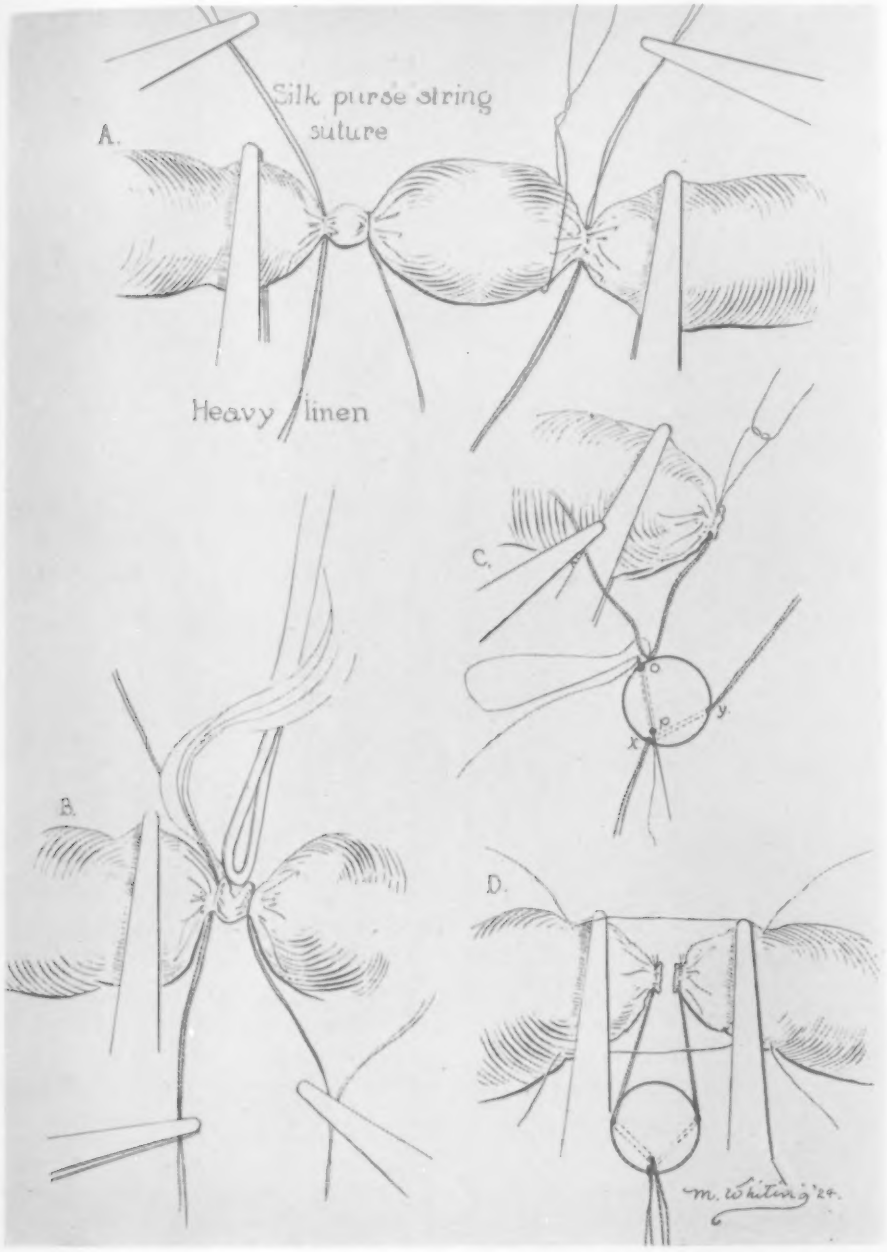

FIG. 2.—A. Half tie in purse-string suture, and ligation at ends of portion to be excised. B. Section of intestine with cautery. C. Knot in purse-string suture completed. D. Two blind ends being prepared for end-to-end anastomosis by the placing of two stay-sutures.

inner forceps are removed, and at each end a seromuscular basting purse-string suture of silk is introduced at the border of the middle crushed ring on the side farthest from the lesion. A heavy linen thread is looped under the purse-string suture at each end,

the purse-string is drawn as tightly as possible and held by means of a half-knot. Ligatures are applied at the crushed rings nearest the lesion and tied. The intestine is divided between the tied ends with the actual cautery (Fig. 2B.) The purse-string sutures are immediately drawn more tightly and the unfinished knots are completed. Two blind ends are thus established aseptically.‡ The linen threads, which have been looped under the silk purse-string sutures, are threaded through the canals of the ball (Fig. 2C). Stay-

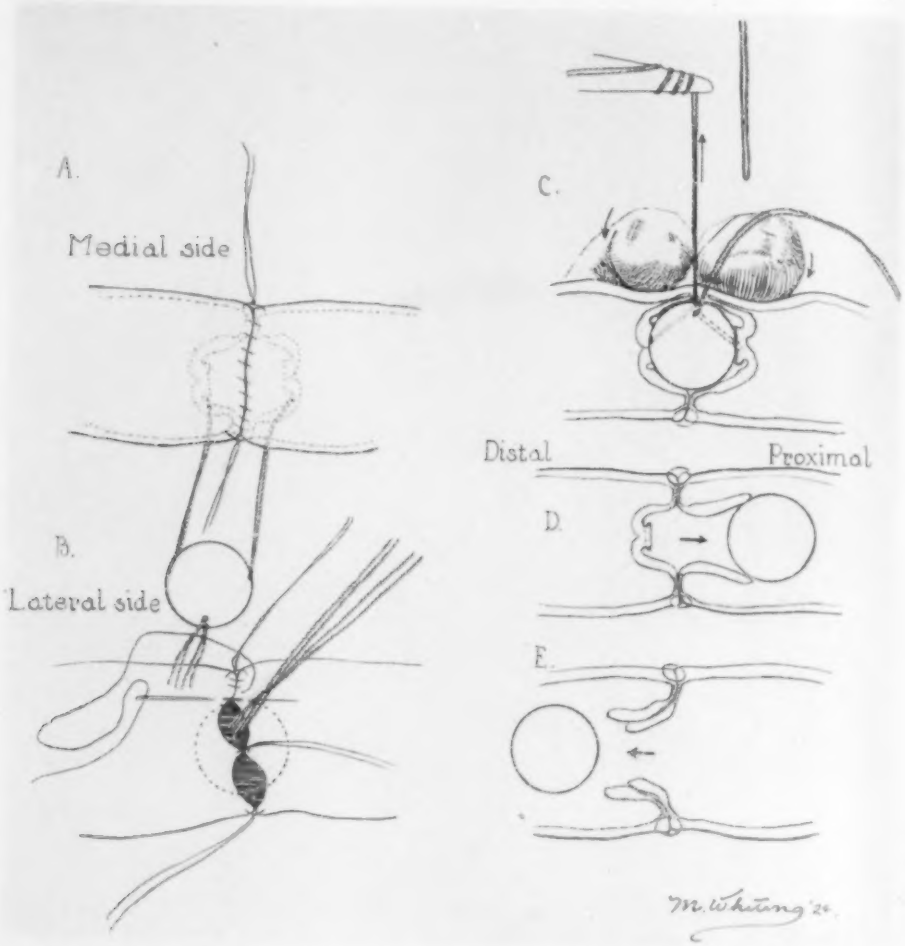

FIG. 3.—A. Half of the circumference of each end sutured after the removal of the two remaining clamps. Crushed ring turned in. B. Blind ends invaginated with threaded ball in chamber and tied in place by interrupted sutures placed previously. Linen threads protruding externally to completed anastomosis. C. Method of opening blind ends after completion of anastomosis. D and E. Opening the ends and removing the ball.

sutures are introduced 3.12 mm. from the crushed rings, on the healthy intestine. The two remaining forceps are then removed. The two ends are approximated and sutured together in the line of the stay-sutures for a distance of one-half the circumference of the intestine, the needle penetrating and catching the submucosa (Fig. 3A). The crushed rings are folded in. The blind ends are invaginated and one or more interrupted sutures are placed on the unsutured side. The threaded ball is introduced into the chamber

‡ Modified from Halsted's Operation: ANNALS OF SURGERY, 1922, vol. lxxv, pp. 356–364.

formed by the invaginated ends, and is held in place by tying the interrupted sutures. The remaining half of the anastomosis is completed, the linen threads protruding to the outside. The silk purse-string sutures, which maintain the closed ends of the invaginated intestine, are now broken by means of the linen threads which are looped under them. This is easily accomplished by immobilizing the enclosed ball by downward pressure with two fingers (Fig. 3C), and after drawing the linen threads taut, jerking them quickly, one at a time. If proper thread has been used, the linen invariably breaks the silk. Proof of the break is had by the appearance of the intact linen loop externally. The intestine does not appear to be injured by the passage of the thread, and there has never been any separation of the suture line at its point of emergence. To reëstablish the continuity of the intestinal lumen the ball is gently pushed through the proximal end of the chamber beyond the anastomosis, and then distally through the other flap and on to the rectum, if desired (Fig. 3C, D, E). In its downward passage the ball places the peritoneal surfaces of the inturns in apposition. By its passage it is proved that no obstruction exists. The flaps slough off completely at the crushed rings, just within the suture lines, within five to eight days. The use of a second row of seromuscular sutures is a matter of choice.

Discussion.—This operation is theoretically aseptic. It is impossible, however, to be sure that the needle will not penetrate the mucous membrane at some point, thus contaminating the entire suture line. For this reason it would seem safer to use interrupted sutures. The technic is simple. There is complete control of hemorrhage, due to the sutures, and to the prolonged crushing of the invaginated intestines near the suture line.

There is no obstruction in this operation, as proved by the passage of the ball. The introduction of a foreign body into the lumen of the intestine has been objected to, with good reasons, but these reasons are not applicable here, since the ball can easily be removed from the intestinal tract.

It is possible that the ball can be made from some soluble material. Unless this is done, the operation will of necessity be limited to the large intestine.

SARCOMA ASSOCIATED WITH OVARIAN FIBROMA*

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Ovarian fibromas and fibromyomas compose from 2 to 3.5 per cent. of the tumors of the ovary. They may develop at any age after puberty. In the cases reported in the literature, the youngest patient was fourteen years.

Fig. 1.—Cut surfaces of fibroma of the right ovary. The sarcoma is shown at one pole of the ovary and scattered through the fibroma at A (Case I).

Ovarian fibromas usually cause rather mild symptoms. Dull pain in the lower abdominal quadrants, aggravated by standing or walking, enlargement of the abdomen, urinary symptoms, and constipation are some of the most common manifestations. Twisting of the pedicle of an ovarian fibroma causes acute pain, resembling that following torsion of a pedunculated ovarian cyst.

Sarcoma of the ovary is uncommon; only two were found at the Mayo Clinic in a series of cases of thirty-nine solid malignant tumors of the ovary in which abdominal section was performed. MacCarty and Broders believe that many so-called ovarian sarcomas are really carcinomas, and that sarcoma rarely occurs in the ovary. C[illegible]vers agree that rapidly growing highly malignant round-cell sarcomas occur most often in the young, and the more highly differentiated fibrosarcomas in adults. Kaufmann suggests the pos-

* Submitted for publication, December 23, 1924.

sible origin of sarcomas of the ovary from the "ancestral" fibroma. Meigs describes a case of sarcoma in an ovarian fibroma similar to the two reported here. Reel mentions an example of a sarcomatous change in a fibrous ovarian tumor. Except for these we have found no similar cases reported in the literature.

REPORT OF CASES

CASE I.—A woman, aged fifty-five years, came to the Clinic because of a recurring vaginal discharge, frequency and urgency of urination, "indigestion," and headaches. She was the mother of three children. Her last menstruation occurred at the age of forty-five. Since then her health had been poor. A sister died of cancer. The cervix had been amputated with relief from the discharge for one and one-half years. Six months before, the discharge had recurred.

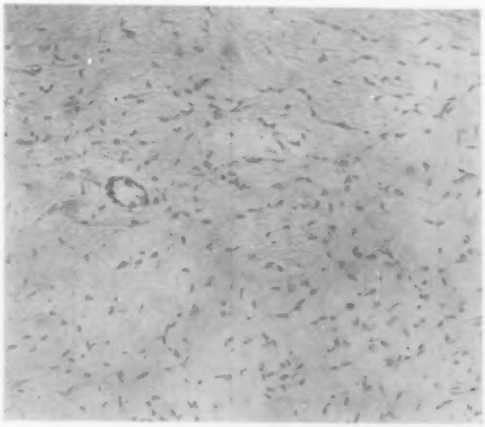

FIG. 2.—Section from the fibroma illustrating its structure, rich in connective tissue, poor in cells (Case I). (X 60.)

There was bleeding from the vagina during the physical examination. Through the rectum a hard nodular tumor could be felt in the position of the uterus, pushing it to the left. There was a slight secondary anemia. The uterus, both fallopian tubes, and the ovaries were removed.

The uterus measured 6 by 4 by 3 cm. Just beneath the endometrium was a fibromyoma 1 cm. in diameter. The left ovary was 3 by 2 by 2 cm., atrophic, gray and firm. Both fallopian tubes were patent. The right ovary was 8 by 7 by 6 cm., white, hard and slightly nodular, and weighed 130 gm. At one pole was a raised light brown ridge, 6 by 3 by 2 cm. Cut surfaces of the right ovary before it was fixed in formalin were light gray, and stippled with soft, finely granular, and tan-colored areas (Fig. 1). The largest of these was 9 by 4 mm. The brown ridge, already mentioned, was soft, friable and closely resembled the tan areas.

FIG. 3.—Cellular fibrosarcoma apparently infiltrating the fibroma (Case I). (X 60.)

Microscopic examination disclosed apparently thin endometrium, and the glands widely separated by infiltrated tissue. The uterine arteries were sclerotic. The left ovary was typically fibrous. There was a fibroma of the right ovary, and infiltrating and invading this a fibrosarcoma (Figs. 2 and 3). No capsule was demonstrable between the benign and malignant tumors. Mitotic figures common in the sarcoma cells. This patient was alive three months after the operation.

CASE II.—A woman, aged sixty-two years, the mother of seven children, came to the Clinic because of rapid enlargement of the abdomen beginning four months before. There was a dull, dragging pain in the right iliac region, especially noticeable after the

patient had worked or been on her feet all day. She had "gas on the stomach," was constipated, and had lost slightly in weight during the last year. She had passed the menopause at fifty. In 1914, the appendix and gall-bladder had been removed at the Mayo Clinic. At that time a note was made that the patient had an old pelvic inflammation on the left side which was not disturbed. A second laparotomy was performed in the Clinic in 1919. The abdominal cavity contained about two gallons of clear fluid. There was a large spontaneously ruptured cyst of the left ovary containing in its cavity a solid tumor. The right tube and ovary were grossly normal, and were not removed. The ascites was apparently from the ruptured cyst.

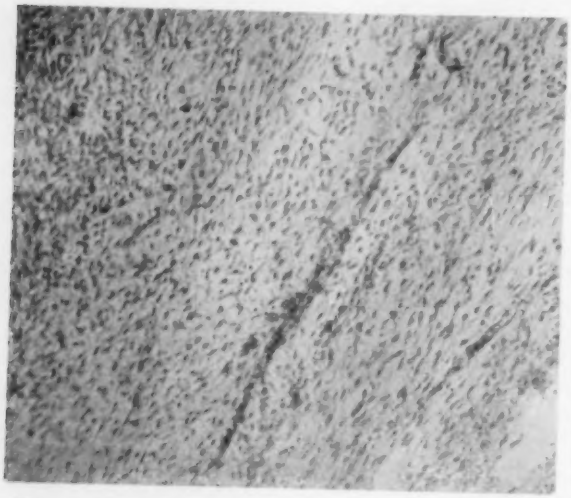

FIG. 4.—Section from œdematous fibroma (Case II). (X 60.)

Examination of the left tube and ovary revealed a thick-walled tube, the mucosa apparently being the seat of an old inflammation. The ovary was a large sac, 16 by 15 by 10 cm., weighing 150 gm. Inside the thin-walled cyst was a hard nodular gray tumor 8 by 5 by 3 cm. After five years in 10 per cent. formalin the cut surfaces of this hard mass were white to light cream color, dotted with blue and black hemorrhages. Interlacing whorls and bands of fibres were prominent. In some places the tumor was soft, in others, firm.

Microscopically the tumor was made up chiefly of fibrous connective tissue cells. In areas the cells were widely separated, apparently by fluid. In other sections, taken from the soft areas, the connective stroma was invaded by many cells with highly staining nuclei. These cells were closely packed together (Figs. 4 and 5). In the sarcoma cells there were occasional mitotic figures (Fig. 6). This patient was alive two years after operation.

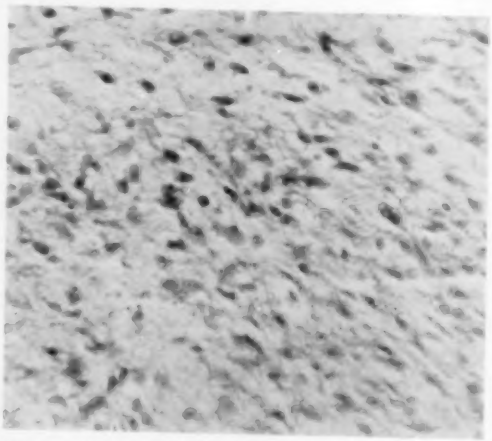

FIG. 5.—Ovarian sarcoma. Compare with Fig. 4. (Case II). (X 120.)

Discussion.—It is not possible, from a study of these two cases, and the one reported by Meigs, to draw a clinical picture of this ovarian disease. Both of the Mayo Clinic cases were complicated by other pelvic conditions that interfered with specific deductions. Meigs' patient was fifty-three years old, married, the mother of one child, and had passed the menopause. The patients discussed here were in the fifth and sixth decades, respectively, had children, and had passed the climacteric. The clinical symptoms were variable and indefinite. Vague urinary disturbances, constipation, and dragging

pelvic pains were complained of. One woman had lost a little in weight, and the other was slightly anæmic. Meigs' patient had considerable ascites. This condition, although common in cases of ovarian fibroma and sarcoma, was not present in the Mayo Clinic cases. Apparently the hydroperitoneum in Case II was caused by the rupture of the ovarian cyst. None of these symptoms and no combination of them suggests a definite clinical diagnostic entity. Obviously only a tentative diagnosis could be made. The surgeon and the pathologist must establish the exact character of the disease at exploratory operation. Such tumors should be removed. If metastasis has not occurred, a favorable prognosis may be given.

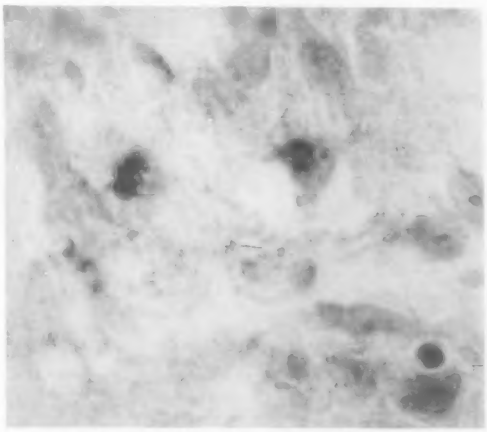

FIG. 6.—Mitotic figure and malignant cells in the sarcoma (Case II). (X 800.)

The fibroma and fibrosarcoma were intimately associated, the latter apparently infiltrating and invading the former. The difference in the structure of the tumors was clearly illustrated by microscopic study. In Case I the specimen was seen immediately after removal. The light tan-colored areas were striking, and suggestive of a malignant new growth.

TABLE I.

Diagnostic Findings.

Case	Age	Menstruation	Marital history	Family history of malignancy	Symptoms	Physical findings	Diagnosis.
1	55	Menopause at 45	Married, three children	One sister died of cancer	Urinary disturbance, "indigestion", headaches	Hard nodular tumor felt through the rectum; slight secondary anemia	Fibroma of the ovary with a fibrosarcoma apparently invading it.
2	62	Menopause at 50	Married, seven children		Enlargement of abdomen, dragging pain in right iliac region, "gas on stomach", constipation, lost four pounds in one year	Enlarged abdomen apparently from fluid	Hydroperitoneum from spontaneously ruptured ovarian cyst containing in its cavity a fibroma and fibrosarcoma.
Meigs	53	Had passed menopause	Married, one child		Enlarged abdomen		Ascites sarcoma in an ovarian fibroma.

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SOME UNUSUAL CASES OF MALIGNANT NEOPLASMS

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This paper presents merely a short description of a few cases of malignant neoplasms which are interesting in regard to the possible etiology or unusual as far as the sex of the carrier, the size and location of the neoplasm are concerned. The accumulation of the records of cases of malignant diseases with any peculiar features might contribute to our better knowledge of these diseases. Therefore the publication of the following observations seems to be justified. All unimportant data in the histories are omitted.

Fig. 1.—Epithelioma engrafted upon sebaceous cyst of the scalp.

Case I.—*Atheroma of scalp, with rodent ulcer of superfacent skin.* Female, thirty-eight years old, single, father died of cancer of the lip; mother died of carcinoma of the breast. Three years before the examination the patient noticed a little tumor on the back of her head which grew slowly. Two months before the first examination she noticed a sore spot on the top of the tumor. To conceal the tumor from view, the patient wore a rough cloth wrapped around her head. The physical examination revealed a large oval-shaped tumor in the occipital region of the skull (Fig. 1), 15 x 18 cm., with a slightly movable skin, soft consistency and pseudo fluctuation. On the top of this tumor, there was an ulcer, 5 cm. in diameter, with irregular outlines, grayish base covered by granulation, and raised, indurated edges. The clinical diagnosis was mammoth sebaceous cyst with malignant degeneration of the superfacent skin. The whole tumor was excised. *Pathological examination:* atheroma with a rodent ulcer of the skin. Patient well, when examined two years afterwards. The notable features of this case are the extraordinary size of the sebaceous cyst and the development of a cancer following a chronic irritation of the skin by a cloth.

Ewing [1] mentions in his book that the sebaceous cyst sometimes develops a somewhat

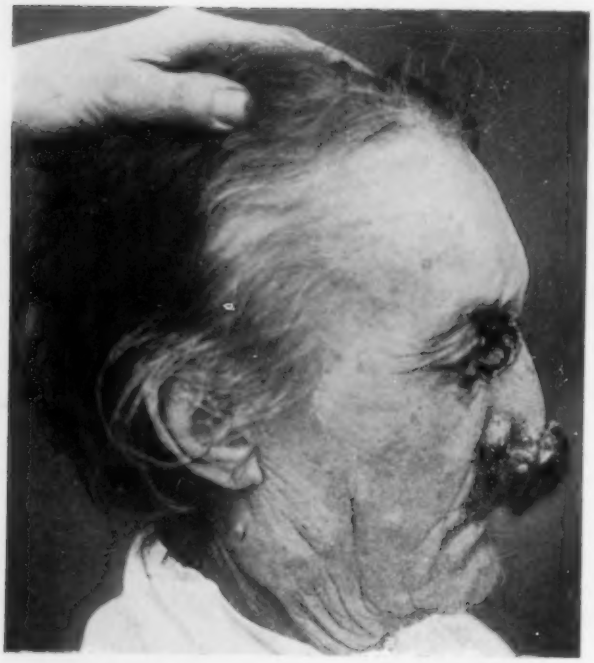

FIG. 2.—Carcinomatous degeneration of lupus of nose.

malignant epithelioma in which the character of the duct-cells is prominent; but in this case the cancer did not derive from the sebaceous cyst but from the overlying skin.

CASE II.—*Carcinoma implanted on long standing lupus of nose.* Female, aged fifty-three, married. Lupus vulgaris on the nose for the last seventeen years. Has been treated for the last eight years with carbon dioxid, radium and different ointments without much success. Three months before examination a hard mass appeared on the tip of the nose; this mass started growing rapidly. Three weeks afterwards the patient noticed another sore place at the internal angle of the right eye. A hard tumor, size of a plum, with irregular surface, covered the tip of the nose. An ulcer, 1 x 2 cm. in diameter, with hard, elevated edges, were situated ½ cm. medial of the internal canthus of the right eye (Fig. 2). Clinical diagnosis: carcinoma of the nose developed on the base of lupus vulgaris; rodent ulcer between the nose and the right eye. Biopsy of the tumors was made; the microscopical examination confirmed the clinical diagnosis. A typical lupus and an acanthoma type of cancer were found in the tumor on the nose and a rodent ulcer in the other specimen. Both tumors disappeared under the influence of radium. Occurrence of cancer of two different types in the same person, one of the tumors developing on the basis of lupus, are the interesting features of this case.

CASE III.—*Carcinoma implanted on long standing lupus of nose* (Fig. 3). The carcinomatous nodules appeared in a man aged fifty-seven, twenty-three years after the beginning of lupus. The structure was that of

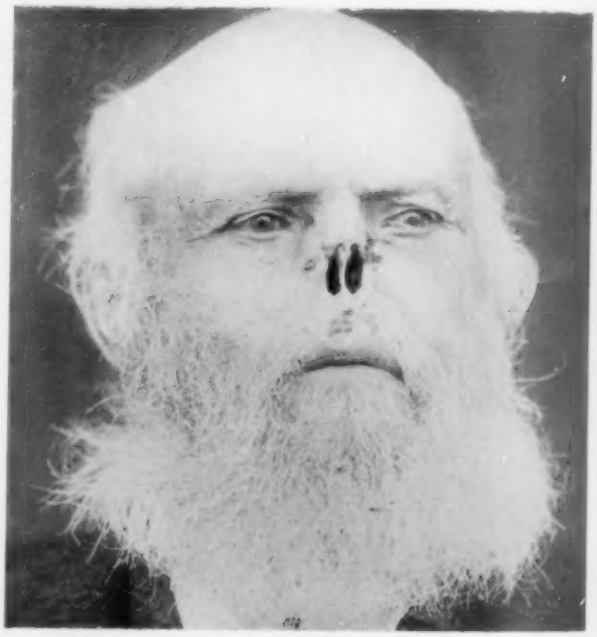

FIG. 3.—Carcinomatous degeneration of lupus of nose.

an acanthoma. This patient never had any treatment; the chronic lupus infection was therefore the only possible predisposing factor for the formation of a carcinoma. Steinhauser[2] has collected eighty-three cases of cancer following lupus. Ashihara,[3] Schumann,[4] Linderborn,[5] also have published the records of cases of lupus-carcinoma. But practically in all these cases some kind of treatment had been applied, and therefore the rôle of the drugs as an irritating and stimulating factor cannot be excluded.

FIG. 4.—Epithelioma of lower lip.

CASE IV.—*Epithelioma of lip; fatal liver metastasis.* Female, aged fifty-nine, married. Since many years she had the habit to move continuously the lower jaw up and down and to bite at the same time on the lower lip. Since five months there has been a slowly growing hard mass on the lower lip (Fig. 4). Clinical diagnosis: a typical papillary cancer involving the whole lower lip. Treatment with radium. Patient died six months afterwards with metastases in the liver. The peculiar chronic irritation of the lip played probably an important rôle in the development of the cancer.

FIG. 5.—Carcinoma of ear.

Occurrence of carcinoma of the lip in woman is not frequent. Among seventy-three cases collected by Warren[6] four were in women. Of 1338 cases Fricke[7] found 91 per cent. in men.

CASE V.—*Carcinoma of ear.* Farmer's wife, aged sixty-five, used for years to sleep on straw, without pillows. She always slept on the left side. The straw frequently caused soreness of the left ear. Two months

before the patient came to the hospital, a tumor started growing on the left ear. Physical examination: the whole left ear was converted into a thick hard mass, 7 cm. in diameter, with irregular surface (Fig. 5). Clinical diagnosis: carcinoma of the left ear. Therapy: excision with electrocautery, followed by fulguration of the base. Pathological diagnosis: simple adenoid epithelioma. Patient well at the date of the last examination, *i.e.*, five months after the operation. The peculiar chronic irritation was possibly an important etiological factor.

FIG. 6.—Carcinomatous degeneration of lupus of ear.

CASE VI.—*Carcinoma of ear implanted on long standing lupus.* Female, aged twenty-eight, single; she suffered since childhood from lupus vulgaris, located in the right preauricular region; various treatments having been without results, patient went seven months previous to admission to the hospital to an uneducated quack who gave the patient an irritating plaster to be applied daily. Few months later a tumor appeared on the site of the lesion. The examination revealed a hard neoplasm embracing the lower pole of the right ear, 5 cm. in diameter, with a ragged surface (Fig. 6). The clinical diagnosis, corroborated by pathological examination of an excised small piece of the tumor, was acanthoma. The interesting feature of this case was the fact that the edges of the tumor were sharply circumscribed, the outline of the neoplasm corresponding exactly to the size and form of the plaster which had been applied for many months. As can be seen from the picture, below the round neoplasm there is a small dark area corresponding to this part of lupus which was uncovered by

FIG. 7.—Lymphosarcoma of neck.

the plaster. This part had not yet undergone malignant degeneration. Radium treatment was apparently very successful. The neoplasm disappeared, leaving an extensive discolored scar. There was no recidive eight months after this treatment.

FIG. 8.—Osteosarcoma of sternum.

CASE VII.—*Lymphosarcoma of neck.* Female, aged thirty-three, married. A swelling on the neck appeared four months before the patient came to the hospital; the tumor rapidly increased in size. When first seen the neoplasm on the right side of the neck extended from the mastoid process to the clavicle (Fig. 7) and consisted of nodules of different size. In spite of the great size of the tumor, there were no signs of compression either of the larynx or of the trachea or œsophagus. Blood examination did not show any pathological changes of the blood. Clinical diagnosis: lymphosarcoma of the neck. X-ray treatment reduced the size of the neoplasm considerably but the patient died two months later. Permission for autopsy could not be obtained. The very large size of the tumor without any symptoms of compression is the remarkable feature of this case.

FIG. 9.—Effect of X-ray treatment on tumors shown in Fig. 8. Note the almost entire disappearance of the right tumor and the lack of any appreciable effect on the left tumor.

CASE VIII.—*Osteosarcoma of the sternum in a child.* Girl, eleven years old. One brother died of sarcoma of the femur at the age of fifteen, one sister died of sarcoma of the arm at the age of eight. Two other sisters living and well. Four months previous to admission to the hospital, the child noticed two tumors on the front part of the chest which grew rapidly in size, forming two very large round neoplasms, about 15 cm. in diameter each (Fig. 8). They were firmly attached to

the ribs and sternum. Consistency moderately hard. X-ray picture revealed large shadows in the right mediastinum. Clinical diagnosis—confirmed by a pathological examination of an excised part of the tumor—osteosarcoma sterni. X-ray treatment was followed with apparently good results on the right tumor but without any success on the left one. Death in two months. The size of both tumors and the occurrence of sarcoma in one brother and one sister are remarkable. It is also interesting to notice that the left tumor resisted the X-ray treatment under which the right tumor disappeared almost entirely (Fig. 9).

FIG. 10.—Primary simultaneous carcinoma of both breasts.

CASE IX.—*Primary simultaneous carcinoma of both breasts.* Female, aged fifty-three, married, six children. Four months before the patient entered the hospital small tumors appeared simultaneously on both nipples; they increased in size very rapidly. The nipples and the region around them was converted into large indurated masses (Fig. 10). There were hard lymph glands palpable in both axillæ. Clinical diagnosis: carcinoma of both nipples. Pathological diagnosis: carcinoma simplex. Mammectomy on both sides was performed and X-rays applied afterwards. Patient was well until eight months after the operation, when metastases in the spine and mediastinum developed and caused death in few weeks.

The simultaneous appearance of neoplasms in both breasts is remarkable. The possibility of one being a metastasis of the other one cannot be excluded absolutely, though it is unusual that a cancer of a nipple causes a metastasis in the other nipple.

According to Ewing,[8] cancer of the breast appears to originate in both breasts in about 1.5 per cent. Handley [9] states that in a series of 1512 cases the opposite breast was involved in 90 per cent. of cases; on the average the secondary growth appeared nine years after the primary. Hubbard [10] finds 9 per cent. of advanced cases bilateral. Benassey distinguished three groups: (1) cancer of the second breast which develops after amputation of the first; (2) cancer developing in the second breast from a focus in the first; (3) primary bilateral cancers which is rare. Our case seems to belong to this group.

CASE X.—*Carcinoma of the male breast.* Male, forty-two years old, married, employee of an express company. Noticed a soreness and a swelling on the right nipple one month before he came to the hospital. He ascribed it to the fact that while lifting heavy boxes he had to lean daily against them chiefly with the right part of the chest.

The examination revealed a flat hard tumor, four cm. in diameter infiltrating the skin in the region of the right nipple (Fig. 11), and involving the lymph glands in the right axilla. Clinical diagnosis: carcinoma mamillæ sinistræ. A radical excision with removal of the axillary glands was performed. Recurrence in five months. Pathological diagnosis: Paget's disease. There were the characteristic intra-epidermal growths especially in basal layers of epidermis. Paget's cells: hydropic, clear staining, large cells with hyperchromatic nuclei.

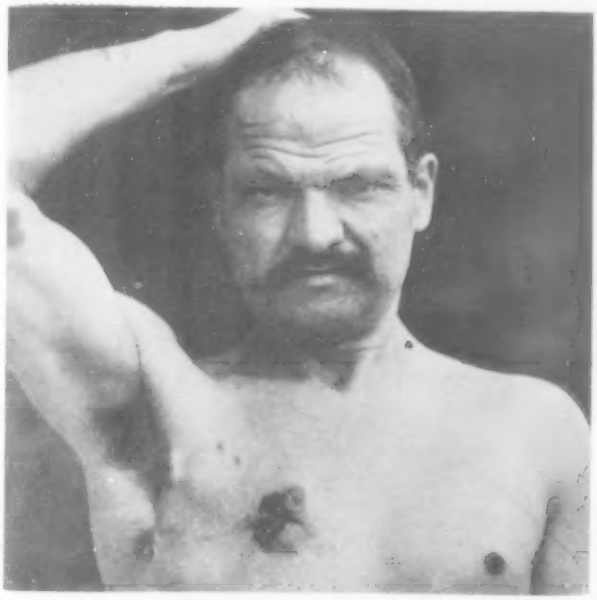

FIG. 11.—Carcinoma of the male breast.

Carcinoma of the breast in man occurs seldom; its frequency is estimated 0.86 per cent. to 6 per cent. (La Forgue,[12] Schuhardt [13]). According to Baumgartner, contributing factors include repeated trauma. Cancer of the nipple is still more unfrequent and Paget's disease in man is very rare (Zieler [15]).

CASE XI.—*Röntgen ray epithelioma of hand.* This case illustrates formation of carcinoma on the basis of a chronic X-ray dermatitis on the hands of an X-ray operator who was engaged in his profession since 1906. He first noticed the milder varieties of X-ray lesions such as eczema, atrophy of the finger nails with the characteristic X-ray hyperkeratoses and telangiectases in 1910. In 1917, a typical cancer had developed on the hand (Fig. 12).

FIG. 12.—Röntgen-ray epithelioma of hands.

Porter,[16, 17] has collected from a careful search of literature eleven cases of undoubted X-ray cancer. Since the time of these publications, however, many more cases of X-ray cancer occurred. (Krause.[18])

Leaving without discussion the other interesting points in these histories the author wishes to emphasize the frequent occurrence of chronic irritation which apparently has led to the formation of carcinoma on quite unusual body surfaces, as cancer of the lip in a woman, Paget's disease of the nipple in man, etc. While the follower of the infectious theory of the cancer regard the chronic irritation merely as a condition favoring the development of cancer by forming a place of a lowered resistance, no bacteria have yet been described which fulfil all the requirements Koch's to be called specific for cancer. It might be just as well that these different species of bacteria cause a chronic infection which similar to the chronic mechanic or chemical irritation acts as a stimulant for the pathologic growth of the epithelial cells. The best example of such a chronic infection leading to the development of cancer if formation of carcinoma on lupus. The cancer in our conception is not a specific disease, not an entity from an etiologic standpoint, but a biological phenomenon caused by chronic irritation, mechanical, chemical, actinic, infectious, etc. This hypothesis does not include the possibility of endogenous factors playing an important rôle in the pathogenesis of the cancer.

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RESULTS OF THE INTRAVENOUS USE OF GENTIAN VIOLET IN CASES OF EXTREME SEPTICÆMIA

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The results obtained by Churchman relative to the selective action of certain dyes in inhibiting the growth of certain bacteria, this action closely following the Gram reaction, and the excellent reports from the clinic of Hugh Young regarding the therapeutic use of these dyes intravenously, have interested us on the Eliason service at the University Hospital so much that we have tried them out in a number of cases. In otherwise hopeless cases it seemed that here we had a faint hope, and in severe cases a valuable adjunct to surgery, but especially in those cases with a blood stream infection caused by the Gram-positive organisms. Recently we had a number of severe cases of generalized peritonitis with death from so-called erythistic shock. The majority of these cases had a Gram-positive organism in pure culture, or as the predominant type in cultures of the peritoneal fluid. This influenced us in the choice of Gentian Violet intravenously as the therapeutic agent to be used in the effort to cut down the high mortality. Treatment of the wounds locally with the dye was purposely omitted.

Starting with its use in moribund cases and in severely ill patients, the scope of usefulness was extended to take in those cases less critically ill. The results obtained in the eleven (11) cases that were treated seem to justify its further use as an adjunct to surgery and in no way as a substitute for it. It is to be considered a part of the pre-operative and post-operative treatment of a given case. In these studies proper surgery was done as seemed indicated at the time of operation. Blood cultures and cultures of pus, fluids and exudates were taken and stained by the Gram technic when possible; otherwise a smear was made and stained by the same technic for the prevailing type of organism. Only where the organisms were entirely or largely Gram-positive was Gentian Violet given. When time permitted leucocyte counts were taken prior to and following the injection, a marked fall in the count being considered a contra-indication to a too early repetition of the injection. The intravenous administration was in no case held up to permit of laboratory investigations in cases where delay might have been serious.

Technic.—In the early cases a 1 per cent. solution of Gentian Violet was made by dissolving 0.5 gm. of the powdered dye in 50 c.c. of freshly distilled (same day) sterilized (autoclave) hot water, using a clean sterile glass measure of 100 c.c. capacity and a clean sterile glass stirring rod. The dye was added gradually over a period of minutes and stirred for twenty to thirty minutes to ensure its complete solution. It was allowed to settle for ten minutes and filtered through sterile gauze and funnel if

necessary. The amount of the solution to be injected was calculated by using a dosage of 5 mg. per kilo of body weight, approximately 23 c.c. of a 1 per cent. solution per 100 pounds. This weight was as a rule estimated in very sick patients.

With a tourniquet on the arm the injection was made in the median cephalic vein through a Wassermann needle on a 30 c.c. Luer syringe. As a precautionary measure a 2 c.c. syringe was first placed on the needle, the latter inserted in the vein and when the backflow of blood was thus assured by withdrawing on the piston the 30 c.c. syringe, filled with the Gentian Violet, was substituted. In this way the difficulty of having to differentiate between blood and Gentian Violet did not occur. In the beginning the injection took five minutes. Certain complications made necessary a change in technic, *e.g.*, four cases developed venous thromboses, one being attributed to leakage around the large needle, another to actual injection through a perforated vein and two to too rapid injection. The use of the hypodermic needle corrected the first fault and in a way partially corrected the last one. The latter was further retarded by prolonging the injection for ten or fifteen minutes and by reducing the strength of the solution to 0.5 per cent. and in one case to 0.25 per cent., increasing the amount of solution injected proportionally. When large amounts of weak strength were used the solution was allowed to run in by gravity through a set used for the intravenous saline infusions.

Within three minutes after the injection in all cases there was a generalized cyanotic color, most marked in the mucous membranes of the tongue, lips, cheeks, and then in the conjunctivæ, face, neck and finger and toe nails. The depth of color varied with the strength of solution and rapidity of injection. The color faded out within two to four hours. There was no chill, rise of temperature, psychic disturbance or complaint on the part of the patient immediately following injections. The only complications that occurred were the four cases of thrombosis, due largely to errors in technic and a transient nausea that occurred on two occasions in one of the patients that had a thrombosis. No cases of diarrhœa occurred. The dye did not stain the tears, sweat, urine, feces, saliva, sputum, or wound discharges. In the cases with thrombosed veins the dye stained the entire thickness of the veins and could be seen for days lending a violet hue to the vein. This thrombosis had largely disappeared after three or four weeks.

REPORT OF CASES

Case I.—This was a child, aged six years, admitted February 9, 1924, with a septicæmia secondary to a furuncle that was opened on its right leg. He was not operated upon and died February 15, 1924. The child was admitted to the Pediatric Service with severe pain in the right ankle and knee and fever for one day. No signs of inflammation except pain and tenderness were present but on the following day appeared redness and swelling with urticaria of the upper half of the body. Blood culture showed a hæmolytic staphylococcus aureus. Surgical consultation was called on the twelfth and Gentian Violet intravenously was suggested. This could not be procured until the fourteenth by which time the child was almost moribund. Its weight was 45 pounds. At 1.15 A.M. 30 c.c. of a 1 per cent. solution was given in the right median cephalic vein over a period of one hour. Marked cyanosis developed almost immediately, followed in five minutes by a generalized miliary pustular eruption, the culture of the pustules showing the same organism as the blood stream. Death occurred twenty-six hours later.

Case II.—This was a man, aged forty-one, admitted to the medical ward in extremis, September 26, 1924, at night with septicæmia. Began with slight fever, chills, and vague pains two weeks before, following an abrasion on the left forearm. Admitted with a tender and swollen right thigh and hip, leucocyte count of 5200, polymorphonuclears 81 per cent. and on the following day was irrational and delirious, his blood culture showing a hæmolytic staphylococcus aureus. Weight was 200 pounds. He was given on September 27, 1924 a dose of 100 c.c. of a 0.5 per cent. solution followed in a few minutes by a miliary intradermal eruption of vesicles and pustules, culture of which again showed the same organism as the blood stream. Death occurred at 3 A.M. the following morning.

Case III.—This was a man, aged twenty-one, who was operated upon September 28, 1924 for an acute, gangrenous, perforated appendix with generalized peritonitis. He was drained and three days after operation developed a bilateral parotiditis, which localized and was drained, followed by immediate subsidence of both glands. Peristalsis returned on the second day. The leucocyte count an admission was 13,000. Two blood cultures were negative but cultures of parotid pus showed hæmolytic staphylococcus albus. Weight of the man was 115 pounds. He was given 52 c.c. of 0.5 per cent. solution on September 28, 1924; 57 c.c. on October 3, 1924 and 60 c.c. on October 7, 1924. In each case there was a drop in the leucocyte count following injection. Cyanosis occurred in three minutes after the injections which took from ten to fifteen minutes. The cyanosis lasted three to four hours. No reactions occurred other than the reduction in leucocytes. Death occurred from sepsis, apparently, on October 8, 1924 with a soft abdomen showing normal peristalsis. Both parotid glands had stopped discharging and were small.

Case IV.—This was a boy, aged thirteen, operated upon July 31, 1924 for acute appendicitis with peritonitis and drained. White blood cells on admission 15,600. The Gram stain of the peritoneal free fluid showed many Gram plus diplococci, a few Gram plus rods and a few Gram-negative rods. Culture showed the Bacillus acidi lactici, and Bacillus pyocyaneous. The boy weighed 60 pounds and twenty-six hours after operation was given 15 c.c. of a 1 per cent. solution. Only a slight change in color was noted with a reduction in white blood cells and a slight venous thrombosis. He later developed a pyelophlebitis with liver abscess which was drained August 21, 1924 after a blood culture was found negative. Culture from the liver was non-hæmolytic streptococcus mitis. Recovery.

Case V.—This boy, aged nine, was operated upon August 1, 1924 for a perforated appendix with generalized peritonitis, and was drained. White blood cells 14,500. Culture of the pus showed a pure culture of staphylococcus albus. The boy's weight was 55 pounds. Three hours after operation he was given 30 c.c. of a 0.5 per cent. solution over a period of ten minutes followed by cyanosis in four minutes. There were no complications and the boy had an uneventful convalescence.

Case VI.—This was a boy, aged seven, who was admitted with acute osteomyelitis of the right femur, clavicle and malar bone and who developed in the course of his stay in hospital further foci in the right ribs and left femur. He had in all, six operations for drainage. Before admission he had been treated five days for rheumatism and was in bad shape. Admitted August 6, 1924. Weight 45 pounds. He was given 20 c.c. of 0.5 per cent. solution on the day after admission, which was followed by cyanosis for three hours and a reduction in white blood cells from 29,500 to 26,300. Blood culture negative but smear of the pus showed a predominance of Gram-positive organisms. A second similar injection was given four days later. Culture of malar pus on that day (August 11) showed staphylococcus auranticus in pure culture and on August 14, pure culture of non-hæmolytic staphylococcus albus. A second blood culture on August 22, was negative. Culture from left femur showed pure culture of hæmolytic staphylococcus albus. Following his last operation on the left femur September 23, the boy rapidly gained weight and strength, his only setback occurring in a fracture of the involucrum of the right femur during an X-ray examination. This healed without shortening.

Case VII.—This case was a boy of eleven and a half years, admitted March 23, 1924 with a subacute osteomyelitis of the upper end of the right femur, likewise having been treated for rheumatism. He had a high intermittent fever. Blood culture was negative. His weight was 90 pounds. Operations for drainage on March 26; April 23 and May 19. He was given 16 c.c. of a 1 per cent. solution on April 21; May 29; June 3 and July 10, since culture of the wound showed hæmolytic staphylococcus albus and clinical improvement was slow. The injection time averaged nine minutes and in each case the temperature took a drop. Some induration took place around the site of the first injection several days later but gradually cleared up. He was discharged September 12, 1924, with a normal temperature. The leucocyte counts remained almost stationary.

CASE VIII.—This was a man of fifty-nine years, admitted April 25, 1924 with tuberculosis of the right knee-joint complicated by a secondary infection, and with the development from time to time of multiple abscesses of the soft parts for which he had drainage on numerous occasions. Knee was drained on April 28 and May 9 and amputated June 9, 1924. The disease followed influenza six years previously. Culture of the pus showed slightly hæmolytic staphylococcus albus. Estimated weight of the man was 125 pounds. Injections were given on May 26, May 29, May 30 and June 4 of 30 c.c., 25 c.c. and 28 c.c. of a 1 per cent. and 50 c.c. of 0.5 per cent. solutions respectively, taking two and a half, seven, ten and seven minutes to inject. Cyanosis lasted three hours and veins became thrombosed after the first, second and fourth injections. Secondary abscesses ceased immediately after injections were commenced and improvement followed each injection although the temperature never reached normal until the leg was amputated.

CASE IX.—This man, aged thirty-two, was admitted July 24, 1924, with a simple fracture of the left femur and a compound comminuted fracture of the lower end of the left humerus into the joint. He was débrided and suspended, the femur being put in a Thomas splint with tongs. A smear showing Gram-positive organisms in the wound and a temperature staying around 99.3 F. suggested the use of the dye. He weighed 115 pounds and was given 55 c.c. of a 0.5 per cent. solution, followed by the usual cyanosis but no abnormal reaction. His temperature rapidly reached normal. No blood culture was taken. Leucocytes increased from 10,000 to 11,200 after the injection. He was discharged October 16, 1924 with ankylosis of the elbow.

CASE X.—This woman, aged thirty, was admitted July 21, 1924, a case of gangrenous ruptured tuberculous cystitis, diagnosed as appendicitis. She had a right nephrectomy five years before for a tuberculous kidney. Culture of the pus from the wound showed a Gram-positive diplococcus. Blood culture was negative. Weight 110 pounds. The gangrenous portion of the bladder was excised and the rest marsupialized. On August 11, 40 c.c. of 0.5 per cent. solution was given. No reaction or benefit followed. She was discharged September 27, 1924, having run a temperature of 102 to 104 during her stay in the hospital. Two months after her discharge she was stronger and getting around without help but with an evening rise of temperature, the drainage wound being pinpoint in size.

CASE XI.—This was a girl of twenty, admitted May 13, 1924 with a massive left empyema following a tonsillectomy. An aspiration of 1200 c.c. of pus was effected May 14, an interrib drainage May 15, and rib resections July 29 and September 17, with drainage of localized pus collections on five other occasions. During her convalescence she developed bronchial fistulæ, ulcerative stomatitis and intestinal ulcerations. Blood cultures were negative but smears showed organisms predominantly Gram-positive. Her weight was 90 pounds. She had Gentian Violet on five occasions: 1. August 7—40 c.c. 0.5 per cent. solution. 2. October 24—100 c.c. 0.25 per cent. solution. 3. October 27—90 c.c. of the same. 4. October 30—90 c.c. of the same. 5. November 1—90 c.c. of the same. The injection took ten minutes and was followed by nausea for one-half hour the first time and nausea and venous thrombosis the second time. There were no reactions after the other three injections. Leucocyte counts were almost stationary. Some improvement in the general condition was noticed. Markedly decreased drainage and exudate prior to discharge November 19, 1924.

Remarks.—Cases I and II were too far gone when surgical aid was called in to be a fair test of the efficacy of Gentian Violet intravenously. In both of these cases the prompt development of vesicles and pustules containing the causative organism has been an evil portent as has proven true in a third case that occurred recently on another service. The staphylococcus aureus seems to be extremely virulent in these cases. In Case III death occurred

probably from toxæmia from the parotitis rather than from a blood infection. Diarrhœa occurred in the case, but prior to the injection of Gentian Violet. The leucocytes were reduced. Case IV had a thrombosis following injection and subsequently a liver abscess developed. Following injection of the dye the wound drainage almost ceased for four days, although the abdomen at operation had been full of fluid. This same marked decrease in drainage also occurred in Case V, and in both cases the leucocyte count was reduced. In Case VI it is interesting to speculate as to whether the dye had anything to do with the silent epiphysitis that occurred in the left femur, since this was discovered by an X-ray examination to note progress of the disease in the right femur. The disease was sharply localized to the upper epiphysis and gave no physical signs, although a subsequent careful physical examination was made. At operation no pus was found, the osteomyelitis being comparable to the so-called non-sclerosing non-suppurating chronic osteomyelitis. The leucocytes were decreased after injection of the dye. In Case VII some induration occurred at the site of the first injection, some leakage probably occurring at the site of injection. Improvement began with the second injection, the temperature beginning to fall and the boy's appetite increasing. The leucocyte count remained stationary. His wound was almost healed on discharge. In Case VIII, thrombosis occurred after three of the four injections from the use of a large Wassermann needle. After each injection the man wanted to get out of bed, his appetite improved and his temperature fell, only to rise again in a day or two. The very troublesome secondary abscesses ceased. In Case IX, the chief effect was the marked decrease in the amount of wound discharge, making dressings necessary only every third day instead of daily. The leucocyte count was increased. In Case X, the injection was a shot in the dark and was of no service. The leucocyte count remained constant. In Case XI, we have a girl brought back from the grave. Her first steady improvement began to follow her course of Gentian Violet injections. The leucocyte count was unaffected, but wound drainage markedly decreased. Thrombosis occurred after one injection from leakage and nausea followed this injection and one other.

Table I shows the results obtained in the 11 cases, and Table II the effect on the leucocyte count.

TABLE I

Improved	7
Unimproved	1
Died	3

TABLE II

Decreased	4
Increased	1
Unaffected	4
No conclusions	2

The following complications occurred as seen in Table III:

TABLE III

Miliary eruptions (Cases I and II).
Thrombosis (Cases IV, VII and VIII).
Thrombosis and nausea (Case XI).

A total of 24 injections were given and thrombosis occurred in 6 veins in 4 patients. Nausea occurred twice in Case XI, one attack of nausea lasting 30 minutes.

In Table IV may be seen the culture and the smear reports on the 11 cases.

TABLE IV

	Blood culture	*Smear or culture of exudate, etc.*
Case I.	Hæm. staph. aureus	Same.
Case II.	Hæm. staph. aureus	Same.
Case III.	Negative	Hæm. staph. albus.
Case IV.	Negative	Bac. ac. lact. and Bac. pyocyan. Non-hæm. strep. mitis.
Case V.	None	Staph. albus.
Case VI.	Negative (2)	Staph. auranticus. Staph. albus. non-hæm and hæm.
Case VII.	Negative	Hæm. staph. albus.
Case VIII.	None	Staph. albus, sl. hæm.
Case IX.	None	Gram-positives.
Case X.	Negative	Gram-positive diplococci.
Case XI.	Negative	Gram-positives.

CONCLUSIONS.—Although in such a small series of cases no definite conclusions can be drawn, yet in noticing the marked decrease in wound exudates in four cases and the clinical improvement in seven, being well marked in four, in addition to the fact that the injections seem to do no harm, it appears that a continued use of the dye in ill and even in the average case may in time increase its sphere of usefulness. At the present time we have another case under treatment that shows the same decrease in exudate immediately following injection of the dye.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held November 12, 1924

The Vice President, Dr. Walton Martin, in the Chair

REMOVAL OF CARCINOMA OF LOWER ŒSOPHAGUS; RECOVERY

Dr. Carl Eggers presented a man, thirty-eight years old, who was admitted to the medical service of Dr. Jacob Kaufman at the Lenox Hill Hospital, March 11, 1924. His chief complaints were dysphagia, vomiting, loss of weight and girdle pain in the upper abdomen. The history dated back only six weeks. It started with a sensation of pressure around the abdomen, as if he were encircled with a tight belt. The sensation gradually became more painful, the pain being intermittent in character. After a while he noticed that it came on after eating, and that vomiting would relieve it. He therefore began to induce vomiting. All this time swallowing had become progressively and rapidly more difficult, so that for the last three weeks he had taken only fluids. Even these had to be taken slowly and in small quantities. He had lost 25 pounds in weight.

He had never been sick before and had never been operated on. Up to the time of the onset of his present complaint he had been in good condition, with good appetite and normal digestion. He denied venereal diseases. For several years he had taken considerable alcohol.

The physical examination was negative. An œsophageal bougie met an impassable obstruction 37.5 cm. from the teeth. Röntgen ray examination showed a deformity about 3 cm. about the diaphragm with almost complete obstruction. This was verified after the administration of atropine for three days, and a diagnosis of malignancy made.

The patient continued to lose weight, and was therefore referred to the surgical service. On March 24, 1924, a Witzel gastrostomy was done. At the same time the upper abdomen was explored; there were no nodes below the diaphragm, a tumor could not be felt through the diaphragm, and there were no liver metastases to be made out. A Wassermann test was 3+. On the strength of this, antispecific treatment was started. Ten days after the gastrostomy an œsophagoscopy and a biopsy were done by Dr. John Kernan. The pathological report made by Dr. Frederick Bullock was squamous-cell epithelioma. The patient had lost 14 pounds since admission and weighed only 114 pounds. The operation was postponed therefore until April 23, 1924, one month after the gastrostomy. His weight was only 119 pounds, but it seemed unwise to wait longer, and the operation was therefore proceeded with.

Under general anæsthesia an incision was made along the left seventh intercostal space, and then carried upward over the 7th, 6th, 5th and 4th ribs. These ribs were then divided close to the tubercles, the vessels ligated and the thorax opened wide. There was no free fluid, no adhesions were found and no metastases noted. The œsophagus was exposed below the arch of the aorta, liberated and lifted out of its bed by means of a tape. It was followed downward to the tumor, which was about two inches long, hard

and nodular. All coats of the œsophagus were invaded by the tumor, and the vagus fibres were incorporated in it to such a degree that they had to be divided. By traction on the tumor it was possible to free it completely and to separate the diaphragm from the œsophagus and bring into view the subdiaphragmatic portion. This part was rather short and made it difficult to place a double ligature, and still have enough stump for invagination into the stomach. The upper ligature was therefore placed rather close to the tumor. The œsophagus was divided by electric cautery and the lower stump then invaginated into the stomach by one silk purse-string suture. It dropped back beneath the diaphragm at once. A few sutures were then placed to close the hole in the diaphragm and the pleura was sutured over it and upward for a short distance to close the raw surface, where the œsophagus had been.

The œsophagus was now liberated behind the arch of the aorta by blunt dissection, ligating smaller vessels. No real difficulty was encountered. The pleura was then incised above the arch, the œsophagus liberated and the lower end with the tumor pulled up from below the arch. While doing this the ligature slipped off, but there was no gross leakage owing to the tight stricture and the cauterization. It was cauterized some more and several sutures taken through its lower end. The œsophagus was now liberated as far as the neck.

The thorax was then temporarily partly closed and the patient turned on his back, and an incision made in the neck along the anterior border of the left sterno-cleido-mastoid muscle. The vessels were retracted outward and the œsophagus easily brought into view. Traction brought out the lower end with the tumor, and it was placed on the thorax, wrapped in moist gauze.

The chest wound was now again opened and the divided pleura at the upper end of the thorax and mediastinum closed by continuous plain gut in order to shut off the neck wound from the thoracic cavity. This could be done without any difficulty. Leakage of air was thus prevented. The thorax was then closed by interrupted chromic gut sutures placed around the adjoining ribs. The muscle layers of the wall were then united in layers by interrupted chromic gut. Skin closed with continuous plain gut.

Previous to closure a stab wound had been made in the 11th interspace posteriorly and a half inch rubber tube inserted three inches for closed drainage. It had a lateral and an end opening. It was fastened to the chest wall by adhesive plaster strapping. Wound dressed and patient turned on his back.

Attention was now given to the neck wound. Muscles closed around the œsophagus. A subcutaneous tunnel was established reaching to the second intercostal space and an incision made at its lower end. Œsophagus and tumor drawn through, and sutured to this transverse incision. Projecting œsophagus and tumor removed with cautery. Neck wound closed with silk, and dry dressing applied.

The anæsthesia had been gas-oxygen-ether, given by Dr. George Muehleck. In the course of the operation the lung had been inflated from time to time, which always improved the condition. This same practice was resorted to while closing the chest and at the end of the operation, with the patient in bed, the drainage tube was opened while the lung was being expanded, forcing out all air. Tube then closed and put under fluid level in drainage bottle, and opened again.

The convalescence was rather smooth. On the day following operation the patient's general appearance was good, he was bright and communicative.

The temperature rose to 103.6 in the evening. There was drainage of 200 c.c. sero-sanguinous fluid.

On the second day the temperature rose to 103.8, with a pulse of 160. He did not look so well, but with stimulation and sufficient fluid by hypodermoclysis he got along all right. After this he gradually improved. There was but slight drainage, and for this reason the drainage tube was removed on the fifth day after an X-ray had demonstrated complete expansion of the lung and the absence of fluid. The chest wound healed by primary union, also the neck wound. There was, however, some disturbance with the œsophageal stump. It became gangrenous and formed a subcutaneous abscess, necessitating drainage and transplantation of the viable portion to an opening at a higher level, just below the left sterno-clavicular joint.

During the first few days after operation no food was given through the gastrostomy tube, for fear of leakage from the cardiac end. On the fifth day the giving of water, milk and a little whisky by the drip method into the stomach was begun. He took 3000 c.c. in 24 hours. Gradually additions were made until he was on a well-balanced diet. As soon as the œsophageal stump had well healed into place, a rubber tube was inserted into it and connected with the gastrostomy tube, and the patient allowed to eat normally. In a very short time he was able to masticate and swallow all kinds of food, and at present does not deprive himself of anything. Food seems to pass down through his rubber œsophagus without any difficulty. Though the patient has been told that he may remove the tube between meals and close the outer end, he prefers to keep it in place constantly, as it permits him to eat without disarranging his clothes.

CARCINOMA OF UPPER ŒSOPHAGUS AND PHARYNX

Doctor Eggers presented a young woman of thirty years of age, who was first seen by him August 1, 1924. She complained of painful, difficult swallowing. Her trouble had started in April, 1924, when she noticed painful sticking sensations in her throat. She paid little attention to it until the increased severity made her consult a physician, who applied some local remedy. This led to complete relief for two weeks. Then the symptoms became worse, and in addition to the sticking pain, difficulty with swallowing developed, which rapidly progressed. On May 31, 1924, she ate her last full meal. For the last three weeks she had been able to take only fluid. Dr. John Kernan had made a careful examination and had done a biopsy on the preceding day. He reported a tumor in the lower pharynx and at the beginning of the œsophagus, which was of an obstructive nature and so friable that he had been unable to pass an instrument. Since this examination there had been a little bleeding, and swallowing had been almost impossible. There was nothing in the past history or the habits of the patient that had any bearing on the present trouble. She had been married five years, and had one child four years old, and at the time of admission was pregnant about four months.

She was a healthy looking young woman. There was no evidence of constitutional disease. The breath was putrid, and the patient seemed distressed by the inability to swallow her own saliva. She made frequent efforts at swallowing which seemed to be painful. She expectorated a great deal. Examination of the mouth was negative. External examination of the neck showed nothing abnormal. There was no glandular enlargement. The larynx was not displaced. It was freely movable and not tender. No tumor was palpable. There was no change in the voice. Heart, lungs and abdomen were

negative. The pregnant uterus reached almost to the umbilicus. Wassermann was negative. *Biopsy report:* Squamous-cell epithelioma.

The case then was a malignant tumor of the œsophagus and larynx, the operability of which was doubtful. The present indication was to feed the patient. A typical Witzel gastrostomy was therefore done on the following day, August 2, 1924, under local anæsthesia. After the patient's state of nutrition had improved somewhat, a radical operation was planned, and it was decided to do it in two stages to lessen shock and prevent mediastinal infection. The first stage was done ten days after the gastrostomy, on August 12, 1924, under colonic ether anæsthesia.

A transverse incision was made at the level of the hyoid bone from one sterno-cleido-mastoid muscle to the other. A vertical median incision was added, reaching to the suprasternal notch. The sterno-cleido and sterno-hyoid muscles were retracted and the sterno-thyroids divided. The thyroid gland was likewise divided and the lobes displaced laterally. The trachea was then completely freed down to behind the sternum. The œsophagus was also freed upward and downward. A hard tumor was felt in its upper end, extending about three-fourths inch below the cricoid cartilage, and upward into the pharynx. It seemed to involve the entire circumference, and apparently extended onto the posterior wall of the larynx. It had not perforated. Only one enlarged gland was found and excised for examination. After the pharynx had been separated from the spine, iodoform gauze strips were inserted behind it and the œsophagus, between the latter and the trachea and also surrounding the trachea and larynx. The skin incision was closed except about one inch in the lower median wound, which was left open for access to the trachea should a tracheotomy become necessary.

There was no difficulty after the operation except a little respiratory distress for the first day or two, probably due to pressure of the tampons. The wound healed by primary union. At times the patient was able to swallow small quantities of water. Her greatest distress was due to inability to swallow saliva and tumor secretion, and the difficulty in expelling them per mouth.

In August, 1924, a week after the first stage, the final radical operation was done, again under colonic anæsthesia. The incisions were reopened, and the tampons removed. The wound was perfectly clean. The trachea was divided between the first and second tracheal rings, cocainized, a tampon inserted into the upper end and the lower end drawn forward and at once fastened into the lower angle of the wound by means of a few silk sutures. The œsophagus was divided about half an inch below the tumor, which was about 1¼ inches below the level of the cricoid. This left a rather short œsophageal stump which could be kept in the field only with considerable traction. By drawing the larynx and pharynx upward and forward it was possible to free them without difficulty as far as the hyoid bone. The thyro-hyoid membrane was divided and the incision completely carried around the pharynx at this level. Specimen removed. Sterno-hyoid muscles divided because they projected forward and interfered with proper closure. The anterior margin of the pharynx was united to the skin edge under the chin, while the posterior margin was sutured to the upper border of the skin flaps. The latter were then partly closed in the median line, leaving an opening for the exit of tampons. Below, two small incisions were made in the margin of each skin flap, thus forming a bridge about three-fourths inch wide, which was interposed between the tracheal opening and the œsophageal opening, and both tubes were then sutured to the skin margins by interrupted silk sutures. One iodoform gauze tampon had been placed behind the œsopha-

gus, and two smaller ones upward behind the stump of the pharynx. Their free ends were brought out through the opening left in the median line, together with two split tube drains. A dry dressing was applied, and moist gauze placed over the tracheal opening. The patient was returned to bed with the foot-end elevated.

The convalescence was very smooth. There was no bronchitis and no crust formation in the trachea, as is so frequently encountered. Three weeks after operation she had regained her normal weight. The wound healed by primary union. The pregnancy has gone on uninterruptedly and has caused no trouble. She expects to be confined next month. The openings in the neck have shown great tendency to contract, so that at present the œsophagus has closed entirely; the pharyngeal opening has contracted to a pin point, and the tracheal opening had become so small that it became necessary about two months after the operation to stretch it and insert a silver canula.

Examination of the specimen showed a tumor of the œsophagus involving all its coats and almost completely surrounding it to such a degree that only a small opening, 2 mm. wide, remained. It encroached on the trachea without involving it and extended up into the pharynx. The microscopical examination showed a squamous-cell carcinoma of the œsophagus. One enlarged gland showed no involvement.

It is the intention to attempt reconstruction of the pharynx from the skin of the neck after the patient's accouchement.

Dr. Howard Lilienthal said that he had learned one thing from work in operating on the œsophagus and that is that these patients do not come to the surgeon early enough to be cured. Doctor Eggers had been fortunate in having a case in which a single segment of the œsophagus with the tumor could be removed. The speaker had never had a case of that kind, although he had one patient, who lived one year and four months, who had to have the tumor peeled away from the aorta. The lesson that this work of Doctor Eggers should teach is that this is a disease which can be cured if the patient comes to operation while the tumor is still an intrinsic one. A permanent cure is not to be expected if the disease has extended outside the œsophagus.

Dr. Franz Torek emphasized the fact that carcinoma is a surgical disease and should be treated by surgical means. So far, the results in carcinoma of the œsophagus have not been brilliant; in the Lenox Hill Hospital 26 cases have been operated upon by his method with but two recoveries. Those surgeons who performed the operation had had to get their experience and they have paid heavily for it. Certain patients should not be operated upon and again others should be simply explored and closed again as soon as it is seen that the tumor has extended beyond the œsophagus itself into another organ. At first it was thought that one could go further in that condition, but it is believed now there should be certain limits to the operation. The two most important indications for operation are that the tumor must be confined to the œsophagus, and the patient must be otherwise in fairly good condition. Although the percentage of recoveries is small, it may not seem so when compared with the very large number of cases treated by radium from which there has not been one single recovery; a fact which should lead more strongly to the belief that carcinoma of the œsophagus should be attacked surgically.

The case on which Doctor Torek operated eleven years and eight months ago is still in good condition and eats heartily.

Dr. Willy Meyer said that this is the second successful case of transpleural resection of the thoracic portion of the œsophagus on record in the world. All who have worked in this line have formed the personal opinion how to advance. It should be remembered that there is the transpleural advance and the mediastinal advance. Considering both methods, Doctor Meyer declared himself in favor of the transpleural route, because it gives the surgeon full control as to inspection and full control of working just as far as the case permits. This is more difficult if the mediastinal route is followed. Here the surgeon has to depend largely on his study of the röntgenograms regarding the level of advance. It is to be hoped that some hospitals will operate on these patients by one method and others by the other method, and then compare notes. But it stands to reason that the transpleural route gives the surgeon a better chance to do full justice to the patient.

Doctor Meyer added that he had said and stated in print for years, that these patients at present come too late for the radical operation. They usually had passed through the hands of many doctors. Doctor Torek's case, now alive after eleven years, came to him before even going to a medical man, and Doctor Eggers' successful case also came early.

It is known that cancer of the œsophagus is the most benign in the human system. It produces metastasis in glands late and it is most frequently squamous. If these cases come to the surgeon in time and are radically operated upon, the glands will often not be found to be cancerous, as in Doctor Eggers' case. Then they can be promised a cure in the future. Let us emphasize, that most likely *two* cases have now been cured by the radical operation.

None have so far been cured by radium. At the last meeting of the American Radium Society last summer, a Chicago specialist gave a résumé of 100 cases treated by radium with no good results. The speaker hoped that the Radium Society and the American Association for Thoracic Surgery could eventually meet in Washington next year and exchange their views and results. After all these years during which so many cases of œsophageal cancer have been treated with radium unsuccessfully, the time has come to discuss this question jointly. It seems that the pendulum would soon swing back to operative surgery.

CARCINOMA OF BUCCAL CAVITY

Dr. Franz Torek presented seven patients upon whom he had operated for carcinoma involving the buccal cavity. He presented these cases on account of the wave of enthusiasm at present prevailing in favor of radium in mouth carcinoma, and to present some counter-evidence as to the relative merits of operation and radium treatment. For instance, in favor of radium the cosmetic result has often been emphasized. If one looks into the mouth of the first patient one will have some difficulty in finding the site of the operation. And naturally so, for the raw surface of the tongue unites with the raw surface of the floor of the mouth, and the only evident manifestation of

the operation is a foreshortening of the floor of the mouth. In this case at first the tongue was bound down to some extent, but now the patient can protrude his tongue fairly well. The external scars, likewise, are in many cases scarcely visible.

Three weeks before the operation the patient felt a lump in his mouth. When first seen he had a growth in the floor of his mouth 3 mm. high and 1 cm. in diameter, extending to the mucosa of the lower surface of the tongue. The lesion was ulcerated. There were enlarged glands in both submaxillary regions and in the upper part of the right sterno-cleido-mastoid region. The cervical nodes were excised, and the lesion in the floor of the mouth, including the adjacent portion of the under surface of the tongue, was excised by the cautery knife. To avoid repetition, he stated that the method of gland excision in all the cases in which gland involvement existed was similar to the one employed in this case; so he would not mention it again. It consisted in a bloc dissection of the submental and submaxillary glands on both sides through an incision from the middle of the chin to the hyoid bone, thence transversely on either side to or near to the mastoid process. The glands were taken out *en bloc* with the fascia covering the digastric, mylohyoid, and stylohyoid muscles. The neck incision started at or near the outer end of the transverse incision and continued down along the anterior border of the sterno-cleido-mastoid muscle. If no involved glands were found where the latter incision crossed the omo-hyoid muscle, the dissection was stopped at that point; otherwise it was carried down to the clavicle. As a rule, in tongue cases, the lingual artery was ligated in the course of this dissection. During the past year he had performed all these operations under regional anæsthesia by first blocking the second and third cervical nerves on both sides, to which was added regional infiltration of the neck beneath the platysma, finally submaxillary infiltration beneath the platysma and up to the buccal mucosa, one finger in the mouth serving as a guide to the point of the needle.

Case II.—*Carcinoma of the floor of the mouth and tongue.* This patient was operated in February, 1924. The case was very similar to the preceding one, involving the floor of the mouth and portion of the mucosa covering the lower surface of the tongue. The operation consisted in bilateral removal of the submental and submaxillary glands and a cautery excision of the lesion.

This patient had no upper teeth, but very sharp lower incisors, ground down to a chisel edge from chewing tobacco. At night he removed the artificial upper set and regularly found on awakening that the tip of his tongue rested on the sharp lower incisors. This irritation occasionally caused a swelling of the tongue; the removal of the lower incisors was advised. As in the preceding case, the scar is scarcely visible.

Case III.—*Carcinoma of the left cheek with involvement of submaxillary glands.* This patient was operated April 27, 1922. The carcinoma on the inner surface of his cheek was about 3 cm. from before backward and about half as much from above downward. The glands were removed through the usual submental and submaxillary incision, which was closed without drainage. The growth on the cheek was removed by splitting the cheek and using the cautery. For a long time after operation he felt a burning sensation in the tongue, but no lesion was ever found there.

Case IV.—*Carcinoma of hard palate.* This patient was operated December 4, 1922. The growth was one inch in diameter and quite prominent. Being firmly fixed to the bone, the bone at the base of the lesion was removed, but the periosteum was preserved on the nasal side, so that the patient might retain a diaphragm between the nasal and buccal cavities. He incised with the cautery knife at a safe margin all around the lesion down to the bone, then

removed the bone with fine chisels, saving the nasal periosteum. As a result not only was the partition between nose and mouth preserved, but new bone has grown, so that he now has a perfect palate with a comparatively small scar. With radium this result would have been impossible. Had radium been used energetically enough to affect the bone, it certainly would also have destroyed the upper periosteum, and a large communication between nose and mouth would have resulted.

CASE V.—*"Mixed tumor" of the palate,* smaller and more superficial than the preceding case, situated at the back portion of the hard palate and impinging on the mucosa of the soft palate. The operation, performed May 16, 1924, consisted in a local cautery incision. The resulting scar is smooth.

CASE VI.—*Carcinoma on the left border of the tongue, later on left side of fauces.* He was operated for carcinoma of the tongue in March, 1917, seven years and eight months ago. The carcinoma involved the left border of the tongue and the corresponding glands. The operation consisted in the removal of the left half of the tongue and the extirpation of the submental and submaxillary glands and the sterno-cleido-mastoid chain. The remaining right half of the tongue is now drawn over to the left side, making it appear as if there were a whole tongue in the mouth. This result is observed after removal of half the tongue, if the mucous lining of the floor of the mouth on the corresponding side has also been removed. It is the natural and inevitable result of raw surface uniting with raw surface. The raw surface of the remaining half of the tongue, which lies in a sagittal plane, is united to the horizontal raw surface of the floor of the mouth, hence the dorsum of the tongue is drawn over to the side.

In May, 1922, a lesion on his left palatine arch was seen, mostly on the anterior, the glossopalatine fold, but also involving the tonsil and the posterior, the pharyngopalatine, fold of the arch. It was a hard, ulcerated growth, characteristically epitheliomatous. The Wassermann was negative. There was no recurrence at the site of the old operation. It was removed with the aid of the cautery in June, 1922. The question naturally arose whether this was a recurrence or an entirely new carcinoma. The latter view seems most probable because there was no local recurrence at the old scar nor any glandular recurrence, and because the new lesion was not directly in juxtaposition to the old scar but at some distance from it.

CASE VII.—*Carcinoma of left side of the tongue.* This patient was operated on May 16, 1916, eight and one-half years ago.

As in the preceding case, the remaining half of the tongue has been drawn over to the opposite side. The speech of both these patients is very satisfactory. A third case of carcinoma of the tongue was operated in April, 1917, but is unable to be present. It was a total resection and yet the patient speaks very well. On writing to him to come here this evening, a reply was received from his son that that patient had been run over and killed.

POST-OPERATIVE BREAST CARCINOMA LYMPH-NODE STATIONARY FOR MANY YEARS

DR. DEWITT STETTEN presented a woman, aged forty-four, who underwent April 19, 1918, a radical amputation of the left breast because of a definite tumor which was diagnosed microscopically by Dr. George L. Rohdenburg as a large-celled, large alveolar carcinoma. The axillary lymph-glands showed no metastatic deposits. The patient made an uneventful convalescence and a post-operative course of X-ray therapy was given over the chest, axilla and supraclavicular regions by Dr. L. G. Cole. A plate of the chest taken at the time showed no evidence of metastases.

April 27, 1919, the patient was examined and a definite, stony hard nodule was noted in the left supraclavicular region. This nodule was not sensitive but quite firmly fixed to the deeper parts. Clinically it had all the ear marks of a typical carcinomatous metastasis in the deep supraclavicular glands. The patient's weight at that time was 127 pounds. The patient declined operation and was not seen again until November 17, 1921. The gland had increased slightly in size and was, if anything, more firmly fixed than it had been, but the patient was otherwise apparently quite well. There was no evidence of any further metastases either in the chest, abdomen or skeleton, and the patient's weight was 142½ pounds.

She has been seen occasionally since that time. The gland has remained practically stationary, the patient is perfectly well and there is absolutely no evidence of any other metastatic disturbance. Her weight now is 151 pounds. Although there is no pathological confirmation of the diagnosis of this lesion and the case is therefore not entirely conclusive, he believed that clinically one is justified in regarding this nodule, which developed about one year after a radical amputation of a carcinomatous breast, as a supraclavicular lymph-node metastasis, which has remained stationary for five years.

POST-OPERATIVE THORACIC DUCT FISTULA

Dr. DeWitt Stetten presented a woman, forty years of age, who was first seen February 4, 1924, with a typical carcinoma of the left breast, with definite, palpable glands in the left axilla. In the supraclavicular region there were a few rather softer glands. The same day a radical removal of the left breast was performed. Microscopic examination by Dr. F. D. Bullock showed carcinoma of the breast with extensive axillary lymph-node metastases. March 26, 1924, the lymph-nodes in the supraclavicular region were excised by a block dissection of all the lymphatic tissue along the internal jugular vein and in the subclavian triangle. The operation was quite simple. The glands were not markedly adherent to the vessels, there was no unusual hemorrhage, and the thoracic duct was not seen during the procedure. A split rubber tube drain was inserted through a posterior stab wound. On gross examination both the superficial and deep inferior glands were seen to be hard and obviously invaded with neoplastic tissue. This was confirmed by the microscopic report, which showed metastatic adenocarcinoma. The neck wound seemed to heal by primary union. The patient was discharged from the hospital five days after operation.

April 3, eight days after operation, a marked swelling was noted over the entire left side of the neck. This swelling appeared to be due to an accumulation of a secretion in the wound which gave a sensation of pseudofluctuation to the swollen area. On loosening the split rubber tube drain there was a rather free flow of milky white liquid, which immediately suggested leakage from the thoracic duct. This drainage continued in a moderate degree for two days, the discharge being more milky in character shortly after meals and more watery during fasting periods. April 6 the rate of flow became really alarming. There was a continuous drainage of astonishingly large quantities of lymph, so that a dressing became soaked within a half hour and required changing. On watching the wound a regular stream of clear liquid could be seen running from the lower angle, which had separated, and from the posterior stab wound. The patient became quite nervous, but the physical effects of the leakage of lymph were, as yet, not very marked. The patient was re-admitted to the hospital and given a continuous Murphy drip. A pyramidal dressing applied with considerable pressure was followed by a rise

of temperature to 102.8° with acceleration of the pulse to 120, was uncomfortable, and only partially controlled the drainage. April 8, under general anæsthesia, the wound was reopened. The cavity was found to be filled with a large amount of accumulated lymph, most of which had coagulated into a yellowish-gray, jelly-like mass. The tissues were covered with a grayish exudate. Behind the internal jugular vein, about an inch above the clavicle and considerably higher than was expected, was seen a small opening from which welled up large quantities of clear lymph. The opening apparently was not the direct opening in the thoracic duct, but was the upper end of a fistulous tract leading down to this. Probing or further opening of the fistula was deemed inadvisable and repeated attempts to close the opening by suture were unsuccessful, owing to the friability of the tissues and the tearing out of the sutures. Thorough tamponade with gauze of the opening and the surrounding regions was resorted to. In spite of the rather tight tamponade to which was added a snug dressing, reinforced by adhesive plaster strapping and pressure from a sandbag, the drainage continued, but to a lesser degree. The patient was, however, more comfortable and the temperature and pulse came down to normal. The drainage continued moderately for three days and then practically ceased. On the fifth day the tampons were removed. The drainage began again and on the seventh day, because it had become fairly profuse, the wound was repacked with gauze but not as extensively as the first time and without general anæsthesia. Within two to three days the drainage again ceased. This time the tampons were left in place for six days, and when they were removed there was no further leakage. There had only been a loss of about eight pounds in weight as the result of the complication, but this loss was regained within a week after the cessation of the drainage. The deep wound healed gradually by granulation and no sequellæ of the lesion of the thoracic duct have developed, either in the chest or abdomen.

Dr. Carl Eggers said he had had to deal with an injured thoracic duct on two occasions. In the first case the duct had been accidentally incised by a colleague during an operation for carcinomatous supraclavicular nodes. The condition was recognized at once and a tampon was packed snugly into the wound and left ten days in the hope of bringing about closure of the opening. However, the packing did not suffice and a profuse flow of lymph resulted, which annoyed the patient very much and resulted in loss of weight. When repeated packing brought no result and the patient became nervous, Doctor Eggers operated, and was fortunate enough to localize the duct, expose the opening which was slit like and about one-eighth inch long, and close it with one fine chromic catgut suture, the way a ureter is closed, after removal of a calculus. The flow of lymph ceased at once. A strip of muscle was laid over the suture and a tampon then lightly packed into the wound. The duct remained closed and the wound healed promptly.

In the second case, also a patient with supraclavicular carcinomatous glands, the injury was also recognized. Immediate attempts to stop the leakage by suture and ligature were not entirely successful. A tampon was therefore inserted and allowed to remain one week. There was profuse drainage the first few days, but then it ceased and the wound healed without difficulty.

Dr. Alfred Stillman said he operated on a young girl in October,

1921, for tuberculous cervical adenitis. She had noticed the swellings in her neck six months previously. Sinuses developed, two behind the sternomastoid and one in front in the right side. October 18, these sinuses and the glands underlying were excised. October 31, a second operation was undertaken for a small group of enlarged glands just above the clavicle on the left side. When removing the last and largest of these, adherent to the thoracic duct, a piece of the duct was accidentally excised with the gland. Efforts to suture the rent were of no avail nor did an attempt at a lateral ligature meet with better success, so a bit of tissue was sutured over the hole in the duct and the wound closed. The wound gradually filled and became semi-fluctuant. December 3, it was re-opened and a mass of coagulated chyle curetted out and the cavity left was packed. After this the wound continued to drain lymph and chyle. She was sent to the country, but returned after three months, having lost about 45 pounds, weighing only 81 pounds, with her sinuses all open and discharging, and running a temperature. She died in the hospital a short time after her readmission.

Dr. Willy Meyer said he had had three cases of this kind all following the extirpation of supraclavicular nodes. In two the condition was the same as in the case of Doctor Stetten, a large accumulation of coagulated fibrin being found within the wound at the time of the dressing. The third case was the one mentioned by Doctor Eggers who was called upon to treat this patient while the speaker was absent from the city. He cured it quickly by exposing the duct and putting around it a ligature, which certainly represents the best treatment. If impossible, firm and deep packing left undisturbed for ten to fourteen days will insure complete final closure of the fistula in most cases.

EXTRAPERITONEAL RESECTION OF CARCINOMATOUS PROLAPSED RECTUM. NO RECURRENCE IN SIX YEARS

Dr. DeWitt Stetten presented a woman, sixty-seven years of age, who was first seen by him in September, 1918, with a large prolapse of the rectum covered by a soft, bleeding, papillary excrescence. On reduction of the prolapse, this tumor mass lay about three inches above the sphincter. Microscopic examination of an excised specimen from the growth showed papillary adenocarcinoma. October 5, 1918, a left inguinal colostomy, first stage, was performed. The gut was opened three days later. October 31, 1918, a Kraske operation was undertaken. After resection of the sacrum the rectum was found to be very much elongated and mobile. The tumor could easily be palpated through the wall. It was quite feasible to perform a resection well beyond the limits of the tumor without opening the peritoneal cavity. An end-to-end suture of the gut was made with preservation of the sphincter ani. The tumor was a large, cauliflower growth with a broad base, apparently arising from the posterior wall of the gut but invading almost its entire circumference. Microscopic examination of the regional lymph-nodes showed an acute inflammation associated with a moderate grade of hyperplasia of the lymphoid elements, but with no indication of tumor metastasis. The wound healed in the main by primary union, but with a persistence of a small fistula and the formation of a moderately tight stricture of the rectum at the level of

the suture. The stricture could be dilated by Wales' bougies up to No. 10. April 29, 1919, this sacral sinus was excised and the stricture divided posteriorly with a urethrotome. The sinus promptly healed and the stricture was eliminated, so that a No. 11 Wales bougie could be passed into the rectum without difficulty. January 8, 1920, he applied an enterotome to cut the colostomy spur, which was accomplished in ten days. March 3, 1920, the final closure of the colostomy was performed and the wound healed by primary union. Since then there has been no difficulty whatsoever as regards the function of the intestine. The bowels move regularly and without difficulty. There has been no evidence of recurrence. On rectal examination the site of resection and former stricture is unrecognizable. Owing to the development of an attack of acute cholecystitis with cholelithiasis, he did a cholecystectomy December 1, 1921, and had the opportunity of making a thorough exploration of the abdomen. There was absolutely no gross evidence of recurrence either in the intestine, retroperitoneal space, peritoneum, or liver. In fact, there were no signs of the previous condition except for some adhesions in the pelvis, and of the sigmoid to the anterior abdominal wall. The patient has always been rather thin, her weight varying from 87 to 95 pounds. Her last weight on October 31, 1924, was 88 pounds.

LUDWIG'S ANGINA

Dr. DeWitt Stetten presented a man, thirty-eight years of age, who was first seen by him November 20, 1923, suffering from a furuncle near the point of the chin. This furuncle had been first noticed about five days previously, when a barber pulled out several hairs because of an infected follicle. A small crucial incision had been made the day before by his physician. There was considerable infiltration around the incision for at least an inch in every direction. The opening was about 1 cm. deep and showed a sloughing base from which drained a bloody serum. There was slight vesiculation of the tense, dusky skin around the furuncle and some œdema of both cheeks. The inner surface of the lip was slightly infiltrated. There were no definitely palpable submaxillary or submental lymph-glands. The temperature was 102°. Moist dressings and observation were advised, but on the following day the patient was admitted to the hospital because it was obvious that the condition was not subsiding and that the lesion was developing into a regular carbuncle. The mucous membrane of the gum in front of the lower incisors and canines was œdematous and on pressure pus emerged between the mucous membrane and the necks of the teeth, although before this infection there had been no dental trouble of any kind. On the same day a crucial incision of the carbuncle was made under anæsthesia and well beyond the infiltrated area. The incision extended down to the bone and necks of the incisor and canine teeth, but the mucous membrane was not opened any further. The wound was tamponed and dakinization begun. The day after operation the local condition was much improved, but the patient's temperature was still 103–104°, and he made a very unsatisfactory impression. The following day conditions were not much changed. The temperature was still high with the pulse rising. The patient was restless and nervous. The wound looked quite clean and the infiltration in the neighborhood had diminished. There was, however, a marked swelling of the neck between the chin and the hyoid bone and the mucous membrane of the floor of the mouth was distinctly œdematous. Bimanually there was a marked infiltration noted of the floor of the mouth, especially on the right side. There was some difficulty in swallowing but no dyspnœa. On the whole, the situation was

assuming a really alarming aspect. After consultation with Dr. John F. Erdmann, it was decided to observe the patient another 24 hours, and if the conditions did not improve, to open the submental and sublingual areas. The next day, three days after the original incision, conditions were obviously worse, the temperature was still high, the swelling had extended more to the left side, even involving the left cheek and angle of the jaw. There was some infiltration along the teeth on the labial side of the jaw, left. The case had now all the appearances of a typical Ludwig's angina, although no fluctuation could be detected. November 24, under general anæsthesia, a wide transverse incision was made between the chin and hyoid bone down to the mylohyoid. The mylohyoid and the geniohyoid muscles were separated bluntly in the median line and the submental and sublingual regions on both sides were opened bluntly by dressing forceps. The subcutaneous tissue was distinctly œdematous and infiltrated, resembling raw bacon, and there was considerable œdema between the floor of the mouth and the muscle planes but no pus was found. Exploration with the finger showed that both lateral pockets extended to immediately beneath the mucous membrane of the floor of the mouth which was not opened. Rubber tube drains and Carrel-Dakin tubes were inserted into each lateral pocket and the skin was widely tamponed with gauze. The carbuncle was revised and the transverse incision extended to the left. A culture from the carbuncle wound showed staphylococcus albus. Unfortunately no culture was taken from the neck wound. The evening of the operation the temperature rose to 105.2°, but the following day the general condition of the patient was more satisfactory and the temperature was somewhat lower. The improvement from that time on was very rapid. The wounds were treated by thorough dakinization. But soon began to drain from the neck wound but the induration rapidly subsided, and the patient's general condition promptly began to improve. The chin and neck wounds healed slowly by granulation. Pus still continued to ooze around the necks of the lower incisors, canines and left first bicuspid—these teeth all becoming very loose. There now followed a long, trying series of purulent accumulations in the mouth along the inferior maxilla, particularly on the buccal side of the left lower molars, in front of the right lower canine, and in the neck at various points, especially near the angles of the jaw. These abscesses were opened at intervals by small incisions and counter-incisions. Drainage invariably continued until superficial desquamating sequestra came away either spontaneously or became loose and were removed with a forceps. Throughout the entire treatment the greatest conservatism was practised. During this period, on December 31, 1923, and January 1, 1924, the left lower first bicuspid and left lower canine became so loose that manual extraction was performed and a few days after these two teeth had been extracted, two large sequestra comprising almost the entire alveolar process for these teeth were removed through their sockets. Several smaller pieces of necrotic bone came away through these sockets in the course of the following two months. By about April 12, 1924, or nearly five months after the initial infection, all the necrotic bone fragments had separated and all sinuses finally closed, except the combined socket of the two extracted teeth, where a fragment of retained periosteum was indicated by the X-ray film. A thorough curetting of the socket with the removal of this fragment was followed by prompt healing. There still remained some swelling of the mandible, especially of the left portion of the body, which X-ray examination showed to be due to a moderate periosteal thickening.

The loose lower incisors and right lower canine gradually became more solid in their sockets, although the two central incisors were found to be no

longer vital. The left central incisor was recently subjected to a root canal filling and the right central incisor was extracted because of an extensive root abscess with apical absorption. After extraction, this socket healed promptly. The swelling of the jaw has gradually subsided and there has been no further disturbance of any kind.

EXTREME ASCITES FROM PORTAL CIRRHOSIS CURED BY COMBINED SPLENECTOMY AND OMENTOPEXY

DR. DEWITT STETTEN presented a man, fifty-two years of age, who was admitted to the Lenox Hill Hospital, December 22, 1923, with a history of having had a chancre at the age of twenty-three. He had been treated for two years with mercurial injections. The patient had been a fairly heavy drinker. In March, 1923, he had a sudden attack of vomiting of blood followed by dark, tarry stools. A second attack occurred December 17, 1923. He had four subsequent attacks up to the date of admission. All attacks were accompanied by dark, tarry stools. He had been losing considerable weight since his first attack of hæmatamesis and in the past few months his abdomen had been gradually enlarging. The patient was quite pale. He had a marked ascites with a definitely enlarged liver, the edge of which was hard and distinctly palpable. The spleen was much enlarged, reaching to the midline and downwards to the level of the umbilicus. The heart and lungs were negative. The neurological examination was negative. There was slight œdema of the ankles. The pulse and temperature were normal. His weight was 159 pounds. The urine, except for a slight trace of sugar on one occasion, was persistently negative. The blood count was as follows: Red blood-cells 2,400,000, hæmoglobin 30 per cent., white blood-cells 5200, polymorphonuclears 62 per cent., large lymphocytes 14 per cent., small lymphocytes 6 per cent., nucleated red cells 16 per cent., eosinophiles 2 per cent. The blood-pressure was 110/50. The Wassermann was 4 plus. The stools were strongly positive for blood. A blood transfusion was given December 9, 1923. A moderate improvement in the condition of the blood was noted following the transfusion. January 14, 1924, a course of neosalvarsan intravenously was begun. January 18, owing to the rapidly increasing ascites, 3000 c.c. of straw-colored, serous fluid were removed from the abdomen. February 6, a second paracentesis was done with the withdrawal of 4000 c.c. of fluid. After tapping, palpation of the liver and spleen was much more satisfactory, the spleen measuring approximately 17 cm. in its longitudinal and 11 cm. in its transverse diameter. The liver edge came down about 5 cm. below the costal margin on deep inspiration. The upper surface of the liver was hard and slightly nodular. A third paracentesis was done February 20, 3000 c.c. being removed. The spleen had increased considerably in size, the longitudinal diameter being 24 cm. and the transverse 14 cm. In spite of the persistent antispecific treatment, the Wassermann remained 4 plus. A second blood transfusion was given February 26, 1924. The abdomen had filled up rapidly since the last paracentesis and the distention was so extreme that the abdominal wall was glossy. The patient was transferred to the surgical service with a diagnosis of extreme ascites, associated with splenomegaly and portal cirrhosis, probably of syphilitic origin. On the assumption that the spleen was largely responsible for the condition, a splenectomy was suggested. This was undertaken by Doctor Stetten, February 28, 1924. Through a long, left hypochondriac split rectus incision the abdomen was opened and between 8000–10,000 c.c. of ascitic fluid was removed by mopping and suction. The spleen was found to be much enlarged, filling the left upper quadrant of the abdomen. It was hard, slightly nodular and showed superficial areas of

infarction on the surface. There were moderate adhesions between the upper surface of the spleen and left vault of the diaphragm and of its hilus to the stomach and pancreas. The liver was markedly enlarged, hard in consistency, and the surface was typically hobnailed in character. After separation of adhesions, the spleen was delivered into the wound and removed. Inasmuch as the liver showed such an advanced cirrhosis, it was decided that simple splenectomy would not suffice and a Talma-Narath omentopexy was performed, an omental hernia being established with the omentum placed and sutured into subcutaneous pockets on either side of the wound. Superficial split rubber tube drains were inserted after suture of the skin.

The spleen was a very large organ, weighing about 2000 grams and measuring 21 cm. in length. The upper pole measured 16 cm. and the lower pole 11 cm. in width. It measured 7 cm. in thickness. On the outer surface were one larger and two smaller areas of fibrosis, evidently old infarcts. The surface generally was somewhat roughened, there was a marked increase of the fibrous tissue throughout the organ, and the general consistency was much firmer than normal. Microscopic examination of the spleen by Dr. F. D. Bullock showed large areas of coagulation necrosis (infarcts) surrounded by hemorrhagic splenic tissue. Thrombi were present in several of the vessels and the lumina of several others were partly obliterated by cellular fibrous tissue. The splenic tissue showed generalized fibrosis with thickening of the trabeculæ and walls of the blood-vessels. The Malpighian bodies were reduced in size and number and the venous sinuses were often dilated and filled with blood. The capsule showed marked localized fibrous thickening and hyaline degeneration. Sections of the spleen prepared by the Levaditi method showed no evidence of spirochætes. Control section of a liver of congenital syphilis showed many organisms. The microscopic diagnosis by Doctor Bullock was multiple infarcts of the spleen, chronic splenitis and perisplenitis. A Wassermann of the splenic blood showed: alcohol 2 plus, cholesterin 3 plus. The operation was very well borne by the patient. The post-operative blood count showed a prompt increase in the red blood-cells with a moderate leucocytosis, red blood-cells, 3,930,000, white blood-cells 10,200, polymorphonuclears 78 per cent., and lymphocytes 22 per cent. Four days after splenectomy the Wassermann was still 4 plus. The wound healed by primary union except for considerable ascitic drainage from the sinuses and between the sutures. March 10, a course of neosalvarsan intravenously was again begun. March 17, the drainage had ceased and the wound had healed, but within a few days the abdomen again became much distended, so that when the patient was sitting up the abdomen was pendulous with glossy skin. The patient was greatly emaciated. The legs and ankles were moderately œdematous. March 27, a paracentesis of the abdomen was again performed and 8050 c.c. were removed. The patient's weight after tapping was 135 pounds. He left the hospital March 30, 1924, but was re-admitted April 12 for another paracentesis, 11,500 c.c. of fluid being removed. A third post-operative tapping was done April 27, at home, 14,000 c.c. being removed, and a fourth on May 8, when 11,000 c.c. were removed. After that time the patient claims that he had polyuria, but that there was no further accumulation of fluid in the abdomen. The œdema of the legs also began to subside and disappeared completely about four weeks after the last tapping. In July, there was a slight, temporary attack of intestinal obstruction, evidently due to the entrance of a loop of gut into the hernial sac. This was replaced by his physician and the obstruction was relieved. There has been no more vomiting of blood and the patient has received no treatment, antisyphilitic or otherwise, since the last tapping. He has gained 30 pounds in weight since

he left the hospital and is now looking for work, his only complaint being the omental hernia. The patient is still somewhat pale, with a blood count as follows: Red blood-cells 2,340,000, hæmoglobin 46 per cent.; white blood-cells 5800, polymorphonuclears 48 per cent., small lymphocytes 2 per cent., basophiles 1 per cent. The red cells appeared rather pale, but aside from a slight amount of poikilocytosis, no pathological cell forms were seen. The liver seems to be about the same size as previously, coming down to about 5 cm. below the costal margin on deep inspiration. It is still hard in consistency but seemingly smoother than before or at operation. There is a large omental hernia which is not reducible. On standing or straining, the gut enters the hernial sac. The skin veins over the hernia are slightly dilated. There is no œdema of the legs or ankles. There is absolutely no trace of ascites, the patient's weight is 164¼ pounds, but the Wassermann is still 4 plus.

Doctor Stetten said that it is difficult to appreciate the striking result that has been obtained in this case unless one had the opportunity of seeing the patient during his stay at the hospital. When he went home they never expected him to live longer than a month or two. When he walked into the office during the latter part of October, Doctor Stetten did not recognize him.

This case seems to confirm the theory advanced in 1921 by William J. Mayo that splenectomy not only relieves the diseased liver of whatever toxic material may be formed in the spleen, but also actually reduces the amount of blood that goes through the liver *via* the portal circulation by at least 25 per cent. This reduction of the portal circulation apparently relieves the hepatic cells of a sufficient overload to enable them to function normally and may even give the liver the opportunity for a certain amount of regeneration. Added to this, the establishment of collateral circulation by the adhesions of the intra-abdominal contents to the bed of the spleen and of the omentum to the anterior abdominal wall, completes the reëstablishment of the portal circulation.

Dr. John C. A. Gerster said that, as Doctor Stetten's associate at the Lenox Hill Hospital, he had observed the patient during his post-operative course. When seen last May the man looked ready for the morgue—one could hardly believe him to be the same person as he appeared now.

CLEFT PALATE

Dr. Charles N. Dowd showed a three-year-old child who had suffered from a congenital cleft of the soft palate, hard palate, alveolar process and lip. The cleft in the alveolar process and in the lip had been at the left of the median line. He was shown to illustrate two points in the treatment of these patients.

First, the development of the posterior part of the alveolar process and the molar teeth. Second, the correction of the nasal deformity.

There have been many acrimonious discussions as to what nature will do in the development of the jaws and teeth when the repair of the lip is done as the primary procedure. For instance, Brophy has emphasized his belief that although the anterior part of the cleft may close under the pressure of the lip, its posterior part will be widened by a pivoting on the malar bones. Other observers believe that the tendency of the whole cleft is toward closure after its anterior portion is brought together. The proper interpretation of the natural process is very important. The entire problem of cleft palate surgery may hinge on it. Therefore the interest of this case. At the age of

three weeks the cleft in the lip and in the alveolar process were closed at once. He was then taken home and was not seen again for three years, although the parents had been requested to bring him for further operation after the lapse of three or four months. The entire cleft in the hard and soft palates had not been touched in the meantime. Hence an unusual opportunity of studying nature's process when only the anterior parts of the cleft have been closed.

Looking at the back teeth, it will be seen that both the lower and upper jaws come together as they do in the normal mouth. There is no spreading of the upper jaw as compared with the lower jaw. The back teeth articulate properly and normally; the front teeth also articulate normally excepting where the upper incisors and canines are defective. This is shown in plate 5 of the paper.

This is good proof, that one may fairly expect a natural adjustment of the upper jaw to meet the teeth of the lower jaw.

The adjustment of the nose and front part of the upper jaw is shown in a still more striking way. The sagging of the nose in these unilateral clefts is distressing. The premaxilla lies forward and the portion of the maxilla, to which the ala of the nose is attached on the cleft side, is correspondingly depressed as compared with its neighbor on the opposite side, hence there is a sagging of the nostril, which makes a particularly disagreeable deformity. In order to meet this condition in this particular case, he did not rely entirely on the lip pressure, but pushed a knife through the soft bone on the sound side, endeavoring to cut between the pulps of the lateral incisor and canine teeth, thus making a greenstick fracture of the maxilla. Since the bone is soft at this early age, it was very easy to then bring the projecting premaxilla backward into its normal alignment. This was further secured by a single wire suture through the bones at the edges of the cleft. It was appreciated that these procedures might interfere with the teeth pulps, but it was believed that the securing of a properly aligned alveolar arch more than compensated for this possible injury.

The result proved that this was true, for the alveolar arch is firm and well aligned, and what is best of all, the nose is so near to normal that one could not ordinarily distinguish any type of deformity. The child is a particularly good-looking child. Fortunately the lip itself has healed in such a way as to show little scar. The edges of the lip cleft were cut away and the raw surfaces were stitched together, at the time of the primary operation. It is unfortunate that the cleft in the palate should not have been attended to long ago, but there is still opportunity to gain a good repair.

THE REPAIR OF CLEFT PALATE

Dr. Charles N. Dowd read a paper with the above title, for which see page 573.

Dr. Frank S. Mathews said that he had no experience with the use of metal plates to support the palate sutures and rarely operated on the hard and soft palate in two sittings. He had operated on several cases of complete clefts on the second day of life, closing the lip only. In such cases, the alveolar cleft usually closes quite promptly as a result of the lip pressure. He frequently uses a single silver wire suture in the alveolus to partially close it at the time of closing the lip. In the very young child, he often spends

fifteen minutes digitally pressing the alveolus into place. He has made many casts of palate clefts at the time of repairing the lip and again at the time of the palate operation. In no case has he had any evidence that narrowing the arch in front made it spread at the back, as has been claimed by those who object to the closure of the lip defect before the operation on the palate. He has never regretted doing the lip operation on a child two or three days old. The trouble about postponing operation until they are one or two months old is that many of them at that age are not in as good condition as at birth, as shown by loss of weight and subnormal temperature. These cases do not do well in the hospital. He thinks it better to let the parent keep the infant at home until it has shown distinct gain in weight and nutrition.

Dr. DeWitt Stetten called attention to an aid in the after-treatment of these cases which had been suggested to him by the dentist to the Lenox Hill Hospital, Dr. S. W. A. Franken. It was applicable particularly in older children, who often disturb the suture line by the constant movement of the tongue. In order to prevent this a splint is made of red dental compound, similar to a plate for a set of upper teeth. The compound is heated by dipping in warm water, flattened out, and readily moulded to the palate and around the upper teeth or gum. It can be held in place by an ordinary chin bandage which keeps the child's mouth closed and can be removed as frequently as necessary for cleansing purposes. It is left in place until the suture line has healed and the sutures have been removed.

Doctor Stetten has recently had a case in which attempts at closure had been made three times previously but had failed because of the constant interference with the suture line by the child's tongue, but succeeded the fourth time with the use of this dental compound protection.

Dr. Harold S. Vaughan (by invitation) said he agreed with Doctor Dowd that alveolar approximation should be obtained and held by a silver wire through the maxilla. The value of this method rests in the fact that it restores anatomical relation, especially in correcting the nasal deformity, when the lip cleft is closed. On observation of a series where such a plan was followed, he had not found any increase in the palate cleft posteriorly.

In double cleft lip and palate with extensive deformity, the speaker said he removed a considerable section from the vomer, so the premaxilla can be carried backward in correct relation. Some operators make the mistake of removing a V-shaped section and only succeed in rotating the bone backward, thus any teeth that develop are directed posteriorly. The margins should be well freshened and firmly united to the alveolar borders so that a good circulatory union is obtained, otherwise this section fails to develop in harmony with the other sections of the maxillæ. Only one-half of the lip is closed at this time, as it is safer to close the other side later.

The speaker confirmed the observation of Doctor Dowd as to the use of iodoform gauze for the lateral incision. He finds it especially valuable in the

incision through which the silver ribbon is placed. This strip of silver is bound around the soft palate to relieve tension on the suture line and is used in the same way as the Mackenty lead ribbon.

He also agreed heartily in early closure of the lip and alveolar cleft. As soon after birth as the baby's condition will permit or before three months of age. Better results are obtained in plastic closure of the hard and soft palate at from fifteen months to two years, as the tissues are then more developed, the arch of the palate is higher and better flaps can be secured.

Doctor Dowd, in closing the discussion, said that one thing stood out conspicuously in the discussion and that was that the contention that the closing of the cleft in front will widen the posterior part, does not hold. The tendency of the arch is to adjust itself properly to the dental arch of the lower jaw. As to the question whether the lip should be done first or the palate first, that is not as important as getting at the case very early and proceeding in the different stages of operation as rapidly as practicable. As far as iodoform gauze is concerned, his personal observations in its use had confirmed him in using it. It gives very important support and remains a long time without getting foul. He did not insist that the hard and soft palates should be corrected in two stages, but he did give the preference to doing it in two stages, because he believed in this way a corrected hard palate was secured at an earlier date and ultimately a much better soft palate.

Stated Meeting Held November 26, 1924

The President, Dr. Eugene H. Pool, in the Chair

HERNIA OF THE TRIANGLE OF PETIT

Dr. John Douglas presented a man, age sixty-one, who was admitted to Bellevue Hospital, June 23, 1923. Patient stated that he had a rupture in the right lumbar region for about twenty months. This, he thinks, was caused by lifting the left arm. It had been bothering the patient, but was not distinctly painful until ten months ago, when he began to have pain. His pain has been growing more severe until at present he is unable to work because of it. Examination showed a mass the size of a small orange in the right flank (Fig. 1), which showed a distinct enlargement on coughing. The mass was reducible and just above the crest of the ilium; in front of the latissimus dorsi muscle is a ring which admits two fingers. There is some tenderness on palpation.

July 9, 1924, a vertical incision through the skin and superficial fascia exposed a mass protruding through an hernial opening just above the right iliac crest in the triangular space bounded in front by the external oblique muscle and behind by the latissimus dorsi. There was no peritoneal sac, the protrusion consisted of retroperitoneal tissue and fat. This tissue was replaced in the abdomen without opening into the peritoneal cavity. The upper part of the triangle could be easily closed by bringing together with interrupted sutures the latissimus dorsi and internal oblique muscles. It still left a space at the base of the triangle just above the iliac crest and this was closed firmly by bringing down from above the fascia above and part of the external oblique muscle across the crest of the ilium and suturing it to

the upper part of the fascia covering the gluteus maximus and medius muscles. There has been no recurrence to date.

Hernia through the triangle of Petit is rare; only two cases have been shown before the Society, one by Coley in 1901 and one by Dowd in 1906. Both of these were congenital. The triangle is formed in front by the posterior edge of the external oblique, behind by the anterior edge of the latissimus dorsi, the base being the crest of the ilium. Its floor is formed by the internal oblique and transversalis. In the case reported by Dowd the upper portion of the triangle was closed by bringing the external oblique and the

FIG. 1.—Hernia of the triangle of Petit before operation.

latissimus together, but this left an opening below which could only be closed by flaps from the fascia over the glutei below and the latissimus behind.

In the present case no flaps were necessary. It is to be remembered that the external oblique is inserted in the external lip of the anterior half of the iliac crest. The internal oblique arises from the middle lip of the anterior two-thirds and therefore extends further back. The hernia protruded from behind the internal oblique which was well developed and nearly all of the opening could be closed by suturing its posterior edge to the anterior edge of the latissimus. Then by mobilizing the anterior margin of the external oblique and the heavy fascia over it, it covered the deeper line of suture, and closed the lower gap when sutured to the fascia below the crest over the gluteal muscles.

CIRRHOSIS OF THE LIVER—OMENTOPEXY

DR. JOHN DOUGLAS presented a man, age forty-four, who was admitted to the medical service of Knickerbocker Hospital, October 14, 1923. For twenty-six years he had been an employee in wine cellars and had drunk considerable wine and beer. He had noticed a gradual swelling in the abdomen of two

weeks' duration. On the day before admission he had some pain and slight jaundice. There was no history of venereal disease and his Wassermann was negative. The abdomen was markedly distended, and a fluid wave was present; the abdominal veins were distended and tortuous. While on the medical service his abdomen was frequently tapped and filled so rapidly, that it was necessary to tap him again every eight or nine days with the quantity removed, averaging about seven pints, increasing with each tapping, and the interval becoming less. He was transferred to the surgical service November 26, and operated on December 1, under local anæsthesia. At operation the abdominal wall showed very free anastomosis of the superficial veins. The omentum was not adherent. The vessels of the omentum were enlarged, the liver markedly hob-nailed in appearance, the gall-bladder not tense, the spleen moderately enlarged but smooth.

A left rectus incision was made under local anæsthesia and the parietal peritoneum roughened with a knife and rubbed with gauze, and the omentum sutured over as large an area as possible, about 4 inches in diameter. After operation the abdomen again filled and several other tappings were necessary, but with the amount decreasing. The wound healed slowly but without infection. January 9, the man had a chill and a high temperature, and developed facial erysipelas of which he had had an attack four years previously. He was then transferred to Bellevue Hospital. At the present time, just one year after operation, he apparently has no fluid in the abdomen, is in good physical condition, although he has a ventral hernia and has apparently been cured of his ascites. It is usually believed by most medical men that very few of these cases of cirrhosis are improved by surgical operation and that the immediate mortality is very high, but this man has been relieved of his ascites by the operation of omentopexy without a splenectomy, which additional procedure could not have been successfully done, with the patient in the condition he was, at the time of his operation.

Furthermore, he wished to call attention to the feasibility of doing an omentopexy under local anæsthesia on a patient in whom a general anæsthetic, by increasing the damage to the already impaired liver and kidney cells, might result fatally.

W. J. Mayo has recently reported on 47 cases of portal cirrhosis in which a Talma-Morison operation was performed. Of these seven died in the hospital and twenty-one were alive when last heard from, of which four were from four to nine years after operation. In ten cases of splenectomy for advanced gastro-intestinal portal cirrhoses, there were three deaths in the hospital and the results on the whole were disappointing. In nine cases of bad "risks" where a combined splenectomy and a Talma-Morison operation was done, two died in the hospital and "the results are none too encouraging."

It was therefore the reporter's belief that both theoretically and practically in the Laennic type of portal cirrhosis, where the spleen is usually not much enlarged (there is an alcoholic history in this case and no history of syphilis and a negative Wassermann), and the change in the liver may be explained by the toxic material carried to the liver by the portal circulation, an omentopexy fulfills the therapeutic indications of relieving the back pressure on the portal circulation. This is in contrast to the portal cirrhosis which appears to be secondary to the enlarged spleen in the Banti stage of splenic anæmia and in which splenectomy is indicated.

Perhaps in selected cases, a combined splenectomy and omentopexy may be indicated, but certainly in advanced cases of both decompensated kidney

and liver function, the patient will not stand a severe operation, and such should not be attempted.

Dr. Charles H. Peck said that several years ago he had two similar cases, one an accidental omental adhesion after exploration. The man had advanced cirrhosis. He was followed for some years and developed large superficial abdominal veins. In the second case an omentopexy was done for ascites and at the end of a year the patient was free from fluid and in good condition. These were the only two successful cases the speaker could recall in the number of cases in which he had performed this operation, but he believed it was indicated in a limited number.

Dr. Allen O. Whipple spoke of a case of cirrhosis with an enlarged spleen in a man of twenty-eight, not of alcoholic origin but from some toxic cause. He accumulated fluid so rapidly and the abdominal wall became so thin that tapping had to be resorted to four or five days apart. The speaker operated on him and left him with a ventral hernia, because of an extensive omentopexy. At the time, though the spleen was greatly enlarged, it was not felt that it would be safe to remove it. He was tapped once or twice after the operation, which was four years ago, but has had no return of fluid since then. He wears an abdominal support.

Dr. George Woolsey recalled a case he had operated on at Bellevue that lived nine years and over. Recurrence occurred in Florida, where he had a severe attack of malaria and began drinking again. Subsequent to operation three or four tappings were necessary. He was shown at the Surgical Society in April, 1910, and subsequently died in Bellevue Hospital. The speaker believed that Doctor Douglas' plan of using local anæsthesia in these cases was very good because many of them are unable to stand the operation, and die soon afterward.

Doctor Douglas, in closing the discussion, said that one of the reasons he showed this case was because he believed omentopexy was suitable and splenectomy not indicated in a limited number of cases, where there was an alcoholic history, marked ascites, and where the spleen was not enlarged. In this type, not due to Banti's disease or syphilis, there should be improvement theoretically and it did occur actually after omentopexy. Of course, if these cases are operated on in a very late stage they will die, but if one takes cases even moderately bad, although they probably would not react after an operation under general anæsthesia, if they are given a chance with local anæsthesia and if the operation is done before liver function is too greatly impaired, some will be saved. If the very bad cases are not operated on, surgeons will not give the operation such a bad name among the internists.

CARCINOMA OF THE FACE WITH PLASTIC

Dr. John Douglas presented a man, age seventy, who was admitted to the surgical ward of St. Luke's Hospital, August, 1924, with a carcinomatous ulcer on the right side of his face, which began eight years ago. At the time of his admission there was an ulcer five by two and five-tenths centimetres in

diameter, elevated, indurated and with rolled in edges, with a base covered with a dirty exudate, adherent to the periosteum over the zygoma and the deep parts. There was an area of extension of the carcinoma well on to the pinna just above the lobe (Fig. 2).

FIG. 2.—Carcinoma of the face and lobe of ear. Eight years' duration.

Operative procedure: An incision was made around the base of the ulcer about one centimetre from its edge. The ulcer was then dissected off the underlying tissues. During the dissection a small branch of the facial nerve was exposed and an attempt made to preserve this. The fascia over the zygoma, the temporalis muscle and the parotid gland were removed. The incision was then carried downward into the anterior aspect of the neck, making an oblong flap of skin with the pedicle attached just behind and below the ear. This was swung upward in position and fastened in place with interrupted sutures. The skin edges where the flap was removed were undermined and approximated.

FIG. 3.—Carcinoma of the face ten days after operation.

The involvement of the pinna required removal of a considerable portion of the lobe of the ear. This was replaced by a part of the redundant upper margin of the pedicle flap as it was swung upward, making an excellent plastic, as partly shown in the photograph. Microscopical examination showed basal-cell carcinoma.

In this patient, notwithstanding extensive radiotherapeutic treatment had been carried on over a period of two years, the carcinomatous ulcer increased in size and microscopical examination of its margins still showed basal-cell carcinoma. There was no carcinomatous involvement of the fascia layer which was removed under the base of the ulcer.

DR. CLARENCE A. MCWILLIAMS said he personally always removed these rodent ulcers surgically, doing the necessary plastic at the same time. One can never tell from the appearance whether it is a basal-celled (non-metastasizing), or a prickle-celled (metastasizing, hence malignant) epithelioma. If one resorts to radium, or the X-rays for treatment, one can tell within two months at the most whether the lesion will be affected at all. If no improvement is noticed after the lapse of this time, surgical removal should at once be instituted. A thousand dollars worth of radium will do a million dollars worth of harm. More harm has been done by it than good. At the Skin and Cancer Hospital, we are continually seeing the harm done by it. A recent example will illustrate. Three months ago, a patient appeared with a recent well-developed but very operable epithelioma of lip with no enlarged cervical nodes. As always in these cases, we advised removal of the local lesion as well as both cervical chain of nodes. He went away and reappeared a week ago. History, had gone to an institution in New York, whose god is radium. Local application of radium was made with total disappearance of lip growth, also radium packs and X-rays to neck. Result, now, two months later, has enlarged glands both sides of neck. Radium into a malignant growth of lip or tongue may cause the disappearance of the local growth, but what about the more than likely infected draining nodes? Does anyone know of any effect upon these nodes of radium or X-rays, except possibly some slight slowing up of their malignant growth? When will the profession come to the realization that adequate surgery is the only hope at the present time of malignant growths?

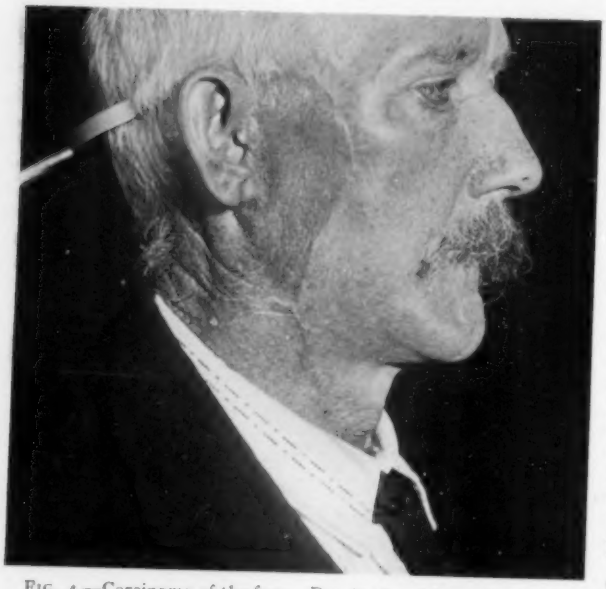

FIG. 4.—Carcinoma of the face. Result of excision and plastic.

DR. WINFIELD SCOTT SCHLEY said he thought it justifiable in the early stages of these cases to try radium. If it cured them, all right; if they came back it might be better to resort to surgery. It is astonishing to see what good plastic results can be obtained in these cases, though at first it seems impossible. He showed photographs of a case, done at the same time as Doctor Douglas' case, of epithelioma below and involving one-half of the lobe of the ear. Plastic repair by Y incision and sliding the flap upward. The remaining part of the ear lobe was turned in to the line of incision and the

result showed a scarcely appreciable scar or defect. He referred to another recent case of extensive epithelioma at the angle of the mouth with plastic repair by sliding flap that gave an excellent cosmetic result.

CARCINOMA OF THE TONGUE

DR. JOHN DOUGLAS presented a man, age fifty-nine, who was admitted to St. Luke's Hospital, April 14, 1924. Two months before admission he began to suffer from pain in back of throat, especially on swallowing, and on moving the tongue, all solid food had to be pushed to the right side. About the same time he noticed small hard nodule below the angle of the jaw on left side. Examination showed a circumscribed, indurated ulcer, one centimetre in diameter, at the base of the tongue on the left side behind the circumvallate papilla and just in front of the glotto epiglottidean fold. A section of this had been removed for diagnosis before admission. Microscopical examination showed carcinoma.

April 19, 1924, the glands of the left side of the neck were removed by block dissection. April 28, under colonic anæsthesia, after ligation of the left lingual artery through the anterior end of the old incision, the posterior half of the left side of the tongue from 7 cm. behind the tip back almost to the epiglottis and including the tonsil and both pillars of the fauces in one mass were removed. This left an area of about one cm. distant on all sides from the edge of the ulcer. The raw surface was sutured over with mucous membrane. He was discharged eleven days later. Examination of the ulcer and one of the glands showed carcinoma squamous-cell epithelioma.

About five months later the patient noticed a lump under the right side of the jaw and he was re-admitted to the hospital. There was a small hard nodule under the angle of jaw on right side. November 3, a block dissection of the right side was done under colonic anæsthesia. Examination showed carcinoma in only one of the lymphatic glands below the angle of the jaw. He was discharged November 17.

The sequence of developments in this case seem to favor the advisability of the removal of the primary growth before the removal of the tributary lymphatics if a two-stage operation is planned. It is fair to assume in this case that as the primary growth was entirely on the left side and did not encircle on the median line and had only existed for two months, that the lymphatic nodes of the right side were probably only invaded in the nine days between the two operations, during which the lymphatic drainage of the left side were blocked off.

DR. HENRY H. M. LYLE said that if one decides that an operation for cancer of the mouth, tongue or lip is to be done in two stages, the important point to decide is which part of the operation should be done first. Doctor Lyle believes there is only one answer to this. The growth should be removed at the first operation, the glands at the second or there will follow just such a complication as Doctor Douglas has emphasized. It is a physical impossibility to remove all the tissue between the tongue and the glands, hence, if there be any cancer cells in the intervening lymphatics, and the natural drainage glands have been removed, one runs the chance of distant lymphatic metastasis. If the glandular defense is intact these wandering cells are taken up and localized and can be removed at a later date by the second operation.

In New York, until the last few years, the teaching had been to remove the

glands, then the growth. The speaker's change of practice dates from a visit to Boston some five years ago; there the practice was to remove the growth then the glands. He has encountered, beside the local cross-skipping shown by Doctor Douglas, distant lymphatic involvement. In a case where a complete block dissection of the right side had been done, lymphatic involvement occurred in the supra-clavicular region of the left side—the original growth being situated in the right angle of the mouth. That this experience is not unique is evidenced by the number of cases of lymphatic recurrences following block dissection of the neck which apply for admission to the New York Skin and Cancer Hospital.

Dr. Clarence A. McWilliams said there could be no question but that the glands should not be taken out first, leaving the local lesion for a second operation, because the cut, infected lymphatics, leading from the lesion, would drain directly into the raw area made by the removal of the glands. He was accustomed in lip and tongue cancers first, to remove the nodes of the neck opposite to the lesion as being least affected and to add to this, at the same time, the removal of the local lesion. Then for the second operation to remove the nodes on the same side as the lesion. This combination would best equalize the severity of the two operations. Doctor McWilliams also wondered whether enough of the tongue had been removed in this case. There is a rich, intercommunicating lymphatic plexus running just along the junction of the lower border of the tongue and floor of the mouth and cancer cells readily progress along these lymphatics. In addition there is a communicating channel leading from the back part of the tongue to the opposite side nodes in the vicinity of the omo-hyoid muscle. He questioned in this case whether it would not have been safer to have removed the lateral half of the tongue.

Dr. Winfield Scott Schley agreed with Doctor McWilliams. In cases where he had done that there had been no recurrence. As regards the glands, he thought it preferable to dissect the glands first. With cancer upon one or the other side of the tongue, he had done hemisection and considered it wiser. His results have been entirely satisfactory.

Doctor Douglas, in closing the discussion, said that he agreed with all of the speakers who advocated the removal of the primary lesion before the excision of the tributary glands. He presented this patient as evidence of the desirability of this procedure. That as far as the advisability of hemiglossectomy was concerned, this growth was very small, only 1 cm. in diameter, and was so far back that when the patient was shown at the staff conference of the hospital, everyone advised his being treated with radium. The growth reached almost to the margin of the epiglottidean fold, but did not encroach on the median line, and that he removed the whole thickness of the tongue with a margin of at least one centimetre on all sides of the growth, together with the tonsil and pillars of the fauces.

In reality more of the tongue was taken out than is apparent, as the tongue has been pulled back toward the affected side by scar tissue. He did

not believe he would have lessened the chance of recurrence by taking off any more of the anterior portion because of the arrangement of the lymphatic drainage in the tongue.

GUN SHOT INJURY TO THE BRACHIAL PLEXUS

DOCTOR DOUGLAS presented a man, age twenty-eight, who was admitted to the Knickerbocker Hospital, October 14, 1923. While standing on the street corner on the evening of admission to the hospital he felt something hit him in the right shoulder, became faint, nauseated, and his right arm immediately became numb and paralyzed.

Examination showed the entrance wound of a bullet over the right deltoid muscle, with no wound of exit. X-ray showed the bullet in the left axilla. Patient was in a moderate amount of shock. A very slight pulsation could be felt in the radial and brachial artery, but this pulse disappeared in the next twenty-four hours, although the hand was warm. There appeared to be a paralysis of all the muscles of the arm, forearm, and hand except of the coraco brachialis, biceps, brachialis anticus, and deltoid. An examination of the sensory distribution of the plexus showed a complete anæsthesia of the whole arm, forearm and hand except of the inner aspect of the arm, supplied by the musculocutaneous and internal cutaneous nerves and over the deltoid region, supplied by the circumflex. The shoulder muscles supplied by the suprascapular nerves were not paralyzed. It appeared that in addition to an injury to the axillary artery, all three cords of the brachial plexus had been injured at a level below where the circumflex, musculocutaneous and internal cutaneous and the nerves to the scapula muscles are given off.

On the day following his admission he had a chill and developed a temperature of 104.4 with obvious signs of pneumonia in the right upper lobes, the bullet having passed through both of these to reach the left axilla. A few days later an X-ray showed a large amount of effusion in the right chest. These chest symptoms gradually cleared up, and on November 7 it was deemed safe to operate on him.

A vertical incision across the outer third of the clavicle dividing the pectoralis major muscle fibres and the costocoracoid membrane and pulling down the pectoralis minor muscles, exposed a portion of the brachial plexus just below the area where the circumflex nerve is given off the posterior cord, and the musculocutaneous the outer cord. The nerves at this level were surrounded by scar tissue, but none seemed to be completely divided. The inner cord impinged into a partly united fracture of the first rib and was involved in the callus and seemed more damaged than the others. The posterior cord was involved in scar tissue, flattened out, and looked crushed, but not divided. The outer cord appeared less damaged than the others, but was also involved in scar tissue.

All three cords were freed from the scar tissue and sutures were inserted in the sheaths of the inner and posterior cords to shorten up and approximate damaged fibres. There was no pulsation in the axillary artery. The transversalis colli artery was markedly enlarged. After operation the arm and wrist were supported and elevated by splints; the patient was discharged from the hospital November 26, 1923. Since then he has been receiving regular physiotherapy at the Reconstruction Hospital. At the present time, just one year after his operation, examination shows there is considerable regeneration and steady improvement.

At the time of accident the only muscles functioning were the scapular muscles, the deltoid and the brachialis anticus, biceps, and coraco brachialis.

He now has considerable power in the triceps and while supination of the arm was present before but no pronation, he now has considerable pronation and a slight amount of radial adduction of the hand. There seems to be a slight contraction in his supinator longus and beginning motion in both the flexor and extensor groups in his forearms to the fingers. There is good flexion and some extension beginning to return at the wrist. He has sensation to the tips of his fingers over the distribution of the radial and median nerve, but ulna sensation stops at the wrist, although he has feelings of paræsthesia in the terminal ulna nerve supply to the hand and fingers; thus sensation has returned over the whole area of the arm and hand except the terminal ulnar distribution. It is to be remembered that the ulnar nerve was the one most severely injured and involved in the callus. As the improvement of both motor and sensory function is steady, it would appear that in view of the progress made in twelve months, a good prognosis may be given. The rate of repair is in proportion to the distance of the lesion from the muscles or sensory area that is supplied by the nerve, approximately at the rate of 1 mm. per day. In these cases of lesion high up in the nerve, repair goes on for a long period. He believed this man would continue to improve for another year or perhaps even two, and there was reason to believe that he would get complete repair eventually. Lewis states that the first evidence of improvement after suture of the external popliteal nerve appeared in most cases after sixteen to eighteen months and that the rate of regeneration differs in different nerves.

TRAUMATIC RUPTURE OF COMMON BILE DUCT

Dr. James N. Worcester presented a man, thirty-five years of age, who on October 6, 1924, while crossing street, was caught between front and back ends of two trucks, compressing upper abdomen. He was brought to the Beekman Street Hospital one-half hour after the accident.

When admitted he was in very slight state of shock. Pulse about 80. His abdomen showed slight rigidity in its upper quadrants. The tenderness and rigidity were more marked on the right side. Patient showed no signs of hemorrhage. During the course of the day he vomited several times. For the next few days nothing of importance was noted. The rigidity of the upper abdomen, however, continued. The fourth day after admission a slight jaundice was first noticed, and bile was found in the urine. Fifth day, jaundice was slightly increased, and it was thought that free fluid was present in the abdomen. Temperature on this day was 101, and pulse 70. Sixth day, fluid was much more marked. Tenth day, patient looked sicker. Fluid in abdomen increasing markedly. Twelfth day, the fluid was still further evident. In order to relieve the pressure in the abdomen a paracentesis was done. About 1000 c.c. of dark brown fluid, having the gross appearance of bile, was removed. More was not removed because patient became faint during the tapping. The following day the distention increased rapidly and produced respiratory distress.

Operation.—October 18, 1924. Twelve days after admission. Right rectus incision. On opening the peritoneum about five quarts of bile-stained fluid escaped; the peritoneum and viscera were intensely colored with bile. There was no evidence of any peritonitis. On exposing the common duct a laceration was found on the anterior surface about one inch above the duodenum. This ran for one-half of the diameter. At the time of operation this was closed and there was no opening into the lumen of the duct. A second laceration was found at the junction of the cystic and common duct. This

had also been closed over by a repair process. After removing all the bile in this region, and in a dry field, and after careful examination, no escaping bile could be found and examination of the portal vessels showed no injury. The peritoneum was washed out with saline and suction apparatus, and a single large rubber tube was inserted into Morrison's pouch. Peritoneum and muscles closed.

Post-operative.—First day eight ounces of bile-stained fluid escaped. Improvement from time of operation was continuous and patient was discharged on the twenty-third day after operation.

Remarks.—This case was shown because of the relative rarity of an injury of the common duct without very serious intra-abdominal injuries. The explanation of the course of the case is that at the time of injury a considerable amount of bile escaped which in the course of time set up an exudate of peritoneal fluid. It is believed that the openings in the duct closed spontaneously shortly after injury.

Dr. Allen O. Whipple considered that this case should go on record. He had never heard of a similar case. The only cases of rupture of the common duct that he knew of had been the result of rupture with calculus and infection.

Dr. George Woolsey said that some years ago he had had a case of rupture of the common bile duct just behind the duodenum. It was in the case of a boy who had been run over. End-to-end anastomosis would have been very difficult owing to the short lower segment, so the proximal end was re-implanted in the duodenum. The child did well for five or six days and then developed peritonitis, from leakage at the anastomosis, and died.

Dr. John A. Hartwell said that the interesting point about this case was that it showed that bile is exceedingly well tolerated by the peritoneum. He had never seen this so well demonstrated as in this case. Bile leakage after the removal of even a moderately inflamed gall-bladder had in his experience always produced serious peritoneal irritation. Doctor Worcester's case emphasized the fact that such irritation arose from coincident infection and not from the bile. He asked if the appearance of the stools had been noticed during the period of observation.

Doctor Worcester, in closing the discussion, agreed with Doctor Hartwell that this case seemed to show great toleration of the peritoneal cavity for bile over a long period. The leakage of the bile must have happened the first few days and then stopped and it set up a chronic exudative inflammation. On the fourth day the stools were said to be light yellow; there were never any absolutely gray-colored stools. The first suggestion of jaundice appeared on the fourth day, and on that day there was positive test of bile in the urine.

MULTIPLE OSTEO-CHONDROMATA

Dr. James M. Worcester presented a boy of eleven years of age, who came to the Beekman Street Hospital with contusions of finger, and in the course of examination, multiple bony protuberances were found. Mother states that these have been present for a number of years. X-ray shows involvement of practically every long bone in body. The family history was not inquired into.

Dr. Morris K. Smith said that he had recently seen a similar case to Doctor Worcester's in a child of seven. The child was brought for advice on account of bowing of the left forearm. This was due to a relative shortening of the ulna, similar to that shown in the X-rays of Doctor Worcester's case, but more marked. The child's grandmother afterward came to the clinic on account of a disability of the left knee and the röntgenogram revealed the same condition. It has not been possible to have the other members of the family X-rayed.

RUPTURE OF JEJUNUM (DUE TO DIRECT BLOW TO ANTERIOR ABDOMINAL WALL)

Dr. Henry W. Cave presented a boy, nine years of age, who was admitted to the Second Surgical Division, Roosevelt Hospital, at 4.15 P.M., on November 6, 1924, with a history of having been struck in the abdomen by a taxicab. He was knocked down by the taxi but not run over. He appeared to be only slightly shocked. He was lying in bed on the left side with thighs flexed on the abdomen. Costal breathing, respiratory excursions being limited in the abdomen. There was no distention of the abdomen and no marks of injury to the skin. On palpation, abdomen very rigid and acutely tender throughout. No point of maximum tenderness or rigidity could be determined. There was perhaps some slight obliteration of the liver dulness, but of this it was difficult to be certain. No other injuries discovered, patient otherwise normal. On admission, white blood-cells 8,000 and polymorphonuclears 74 per cent. His pulse was 112, temperature 100.8. He was seen by the house surgeon who felt at first that it was merely a contusion of the anterior abdominal wall. However, two hours later the patient was seen again. He was more rigid and his temperature had risen to 101.4, white blood-cells 20,900, and polymorphonuclears 89 per cent. Immediate operation. A left mid-rectus incision. Peritoneum opened, presenting almost directly into the wound was a tear in the jejunum which had stretched and was about the size of a half dollar. Intestinal contents were pouring out of this wound in the gut wall. A double row of linen sutures over the rent and a whip-over fine catgut suture was made. The gut at this point after suturing of the wound, admitted thumb and index finger. About three ounces of blood was suctioned out of the peritoneal cavity deep in the pelvis. No blood in the lateral gutters. Spleen, stomach, liver, and the rest of the intestines found to be perfectly normal. Closure of wound in usual way. Uneventful recovery.

It may be of interest to note that on July 1, 1923, one year and four months ago, this boy was brought to the hospital with a rupture of the right kidney, having been struck at that time also by a taxi. Operation on kidney unnecessary and uneventful recovery.

Dr. Charles H. Peck said that some years ago he had a case of rupture of the jejunum a little higher up in the upper third. The patient was a New York physician who was driving his car and was thrown so that the edge of the steering wheel gave him a sharp blow. The accident happened at noon and Doctor Peck operated on him a little under twelve hours later. There was considerable leakage of the contents of the jejunum which was confined to the upper left quadrant. The leakage and exudate were removed, the rent in the jejunum was sutured, and he made a good recovery. It is well

known that the contents of the upper jejunum are less infective than those lower down in the intestine, and these cases operated upon early usually have a good prognosis.

Dr. Winfield Scott Schley referred to a case that he showed before the Society in 1913 of complete transverse rupture of the jejunum an inch and a half below the duodeno-jejunal junction. There was bile-stained fluid and some blood in the abdomen. He did an end-to-end suture and the patient made a good recovery. The interesting feature of this case was the sharp cut of the gut as if it had been done with scissors. The mesentery was undamaged and there was no ecchymosis of the parietal peritoneum. The injury was sustained by a large rock falling upon the abdomen. The gut was crushed upon the spine as often happens in this type of injury. Operation was performed within six hours of the injury.

VAGINAL ANUS

Dr. Henry W. Cave presented a girl, eight years of age, who was admitted to the Second Surgical Division, Roosevelt Hospital, April 24, 1924, on account of constipation, fecal incontinence, and occasionally nausea and vomiting.

She was a well-developed and well-nourished white girl of eight years. Heart and lungs are normal throughout. Abdomen negative. Surgical condition: there is no anal opening at the normal opening site, but in its place there is a deep depression of the perineal skin and underlying soft parts. The vulval cleft is normal to superficial examination. The clitoris labia majora, urethral and vaginal openings are normal. In addition to this is the opening of the rectum separated from that of the vagina by a corrugated septum apparently formed by the joined posterior ends of the labia majora. The hymen is intact. This misplaced opening of the rectum admits the tip of the little finger. It is more of a transverse slit than a rounded puckered anal opening. It was deemed advisable to do a plastic operation to move the anus backward into its proper position.

The child made an uneventful recovery, temperature not going higher than 101 degrees. She had to be catheterized the second day after operation. There persisted a fecal incontinence up to the twenty-fourth day post-operative. Child at this time got up out of bed and was allowed to walk around. Since that time she called for the bedpan or went to the toilet whenever she felt that her bowels wished to move. The wound healed very satisfactorily, and ultimately regained perfect control over every defecation.

Dr. Richard W. Bolling said he had seen three instances of vulvar anus in the early weeks of life. In two the orifice was sufficiently large, so that there was no obstruction and no operation was done. It is generally agreed that it is better to defer operation until the eighth or ninth year. In a number of cases where control was good, the patient's life has not been interfered with at all. A case was reported recently in a French journal of a woman who came to a clinic for some gynæcological condition and this condition was discovered. She had been married several years and neither she nor her family physician were aware of it.

OPERATIVE TREATMENT OF DUODENAL ULCER WITH SPECIAL REFERENCE TO THE HORSLEY OPERATION

DR. JOHN F. ERDMANN read a paper with the above title, for which see page 631.

DR. CHARLES H. PECK said that he had little experience with the Horsley operation because he had rather felt in favor of limiting the operation to gastro-jejunostomy as he had found it gave very good results. It does not guard against early recurrence in the bleeding cases, however. He believed that if hemorrhage is deferred for three or four weeks, it is not apt to occur after that. As to recurrence with marginal or jejunal ulcer, he was sure he had not seen this occur in ten per cent. He had had three per cent. in his whole series and of course the fact is recognized that other ulcers may have occurred. He believed that more radical operations are unnecessary and that it is better to confine oneselves in these cases to gastro-jejunostomy, reserving for a secondary procedure a radical operation if it seems to be necessary. It is unnecessary to do more in 85 per cent. of cases. The final judgment as to the best procedure rests on careful and late follow-up of these cases. As time goes on, the speaker's confidence has been increased that in a large percentage gastro-jejunostomy is an effective operation for the cure of these cases. One cannot safely do a more severe operation with a fixed duodenum; it is only in cases that can be easily mobilized, and in advanced ulcer with fixation of the duodenum patients often obtain a clinical cure and remain well after simple gastro-jejunostomy.

DR. JOHN A. HARTWELL emphasized the statement of Doctor Erdmann that what shall be done in an individual case must be decided at the time the abdomen is opened. Looking over the literature of the last six months the contradictions as to the results of all the methods are so great that it is difficult to explain. One is at a loss to know why enthusiastic reports for gastro-jejunostomy are numerous and yet other surgeons of equally great experience are discouraged over their results. He believed it was wise to keep this subject open and have frequent frank discussions so that finally the truth may be reached. In the investigation that he had made and in cases he had had at Bellevue, some 148, the results of simple gastro-jejunostomy, do not by any means give 90 per cent. of cures. They will yield 80 per cent. if one counts every one up and about and able to attend to business as cured. But if one throws out from the ones coming back because they do not feel well, because of pain or not being able to eat without medication, then one finds the percentage well below 80 per cent. At least 12 per cent. of these cases were failures so far as the benefit of the operation was concerned; their condition was practically unchanged.

DR. CHARLES GORDON HEYD said that in regard to the Horsley operation he had done about fifteen in the last eighteen months. He was surprised at the rapid cessation of symptoms of which the patients complained and their complete freedom from pain. He reserves the Horsley operation for cases where there is no evidence of pyloric obstruction and where the duode-

num is freely movable, and combines it with excision or cauterization of the ulcer. The cases upon which we have performed Horsley are recent, but have been clinically free from symptoms since operation. He had reserved gastro-enterostomy for ulcers with pyloric obstruction with duodenum fixed and bound down.

The association of cholecystitis with ulcer is much more frequently encountered than is generally supposed. He was inclined to believe appendix, gall-bladder and ulcer to be a chronological sequence in pathology.

Dr. Richard Lewisohn said he was doubtful if it would be possible within the next few years to come to a uniform opinion of the proper treatment of pyloric and duodenal ulcers. Opinions as to the best procedure differ widely, as can be seen from the fact that in the last year three papers have been read before this Society, one advocating radical operation, one suggesting gastro-enterostomy, and one in favor of the Horsley operation. The Horsley operation is applicable only to cases of ulcer situated on the anterior wall of the duodenum, and that location is found in only one out of four duodenal ulcers. Doctor Horsley has performed his operation in 64 cases and had six recurrences, certainly a large percentage.

Up to two years ago gastro-enterostomy was the method of choice in the surgical treatment of pyloric and duodenal ulcers admitted to Doctor Berg's service at Mount Sinai Hospital. Only the fact that post-operative results were not good induced them to adopt the more radical procedure as suggested by Haberer. Doctor Lewisohn stated that among the gastro-enterostomies performed between 1915 and 1920 they had 18 per cent. of gastro-jejunal ulcers proven by re-operation, and another 16 per cent. in which the diagnosis was based on clinical symptoms and X-ray findings. Their method in performing gastro-enterostomy does not differ from the usual technic. Trauma of tissues does not play an important rôle in the causation of gastro-jejunal ulcers. In none of the five cases in which the Murphy button had been used did a gastro-jejunal ulcer develop in spite of the fact that the application of the button represents a serious trauma to the tissues.

Contrary to current opinion, gastro-enterostomy does not change gastric hyperacidity. Partial gastrectomy, however, causes an immediate and permanent anacidity in the majority of cases.

Doctor Lewisohn stated that among 28 Billroth I or retro-colic Billroth II, he had one fatality (mortality less than 4 per cent.).

Deaths following operations for gastro-jejunal ulcers should really be tabulated as late deaths following gastro-enterostomy. In this case the mortality following gastro-enterostomy would probably be higher than the mortality following primary resection of the stomach in gastric and duodenal ulcers.

Pribram's statement that gastro-enterostomy is not an operation but a disease, seems to contain a great deal of truth.

DR. JOHN C. A. GERSTER said that to be of value the follow-up should last ten years after any gastric surgery. A few weeks ago he saw a woman who had had closure of an acute perforation and gastro-enterostomy in 1917 (seven years previously) and had been free from symptoms until within a few weeks ago, when she had a massive gastric hemorrhage (later tarry stools). A five-year limit is too low, no matter what the procedure.

DOCTOR ERDMANN, in closing the discussion, said that he believed with Doctor Gerster that the question of cure should not be limited to five or ten years. He had cited cases of recurrence, one eight years after operation, another seven years afterwards, and another after seven years with hemorrhage, whether due to the old ulcer or to a new ulcer he did not know. As to the question of cholecystectomy: in many instances there is an infected gall-bladder, or chronic gall-bladder disease, which is said to be a factor in the etiology of ulcer of the stomach. Otherwise the gall-bladder is prone to become adherent and present symptoms due to adhesions. He believed that an infected appendix or gall-bladder was a factor in duodenal ulcer. He did not drain his cases.

DOCTOR ERDMANN considered Doctor Lewisohn's statements very interesting. He understood that Doctor Berg had stated that 33 per cent. of all his gastro-enterostomies had been followed by evidence of marginal ulcer. Doctor Lewisohn had stated that the majority of ulcers are found on the posterior wall, but the speaker believed that the majority were on the anterior and superior surface. As to Doctor Horsley's own failures, Doctor Erdmann had received a communication from him lately and he wrote that he was careful of the mucosa. If there were infarctions or thromboses from suturing of the mucosa, these might be productive of marginal ulcer. But Doctor Erdmann thought that if that were so, there would always be marginal ulcers and many more than are recognized. He did not believe a foreign body of non-absorbable material was the cause of marginal ulcers.

DOCTOR ERDMANN said he had started out with the statement that he held no brief for the operation of Horsley; he was merely citing a series of cases. The operation had become a fascination to him; he has done 67 and will go to 100 before he finishes, provided no reasons for ceasing arise.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held December 1, 1924

The President, Dr. Edward B. Hodge, in the Chair

EXOPHTHALMIC GOITRE WITH LARGE THYMUS

Dr. Edward J. Klopp reported the history of two patients with this condition. The thymus in both was considerably larger than the average found at autopsy in persons dead of exophthalmic goitre.

Case I was a colored girl of twenty, admitted to the Pennsylvania Hospital, May 9, 1922, under the care of Doctor Gibbon. The enlargement of the neck was noticed three years before, following an attack of scarlet fever, gradually becoming larger. Frequent palpitation for two years, rather nervous, not conscious of any eye symptoms. Best weight, three years ago, 130 pounds; present weight, 109 pounds. Typhoid at eight; bronchitis almost every winter. Menses established at fifteen, regular and normal. At seventeen would sometimes miss a period. Last period was on December 12, 1921. Teeth are in bad condition; tonsils are cryptic. There are no eye symptoms. The thyroid is symmetrically enlarged, a thrill is palpable, a bruit is heard over the gland, pulsation is easily visible. Heart impulse is forcible—seen and heard all over præcordium. There is a coarse tremor of the hands; no cyanosis or clubbing. Leucocytes 6800. Wassermann negative. She was treated with the X-ray June 26, 1922. The pulse was 130.

Operation.—October 10, 1912, 2 P.M., by Doctor Gibbon. Resection of thyroid. The ribbon muscles were adherent; the veins were large and numerous. There was considerable bleeding throughout the operation. Pulse rate 180. The patient was in fairly good condition until the following morning at three o'clock when, according to the nurse, breathing suddenly became slower and more labored and death occurred in five minutes.

Autopsy.—Doctors Flick and Hayman. Heart muscle, adrenals, liver, spleen, peritoneum, intestines and parathyroids appear normal, uterus infantile 5 x 3 cm. Thymus 50 grms. Bronchopneumonia. Examination of thyroid by Dr. H. S. Newcomer. Laboratory specimen 11 x 5 cm. It is a solid struma and is not remarkable.

Microscopical Examination.—The thyroid contains very little colloid substance. There is some in certain areas. The alveoli are not very large. They are everywhere almost filled by overgrowth of the lining cells with papillation and involution. The cells are many of them desquamated. They frequently show mitotic figures and the whole has a very active appearance. Diagnosis: Struma of exophthalmic goitre.

Case II.—A white woman, married, thirty-three years of age, was admitted to the Jefferson Hospital, September 29, 1924, complaining of nervousness, indigestion, and vomiting, palpitation, and swelling in anterior part of neck. Menstrual history normal. Married nine years, no pregnancies.

General health good until present illness, which began in April, 1924, with vomiting. The following day she had palpitation and rapid breathing. She

then became very nervous and remained so ever since. She spent most of her time in bed. Admitted to a hospital in a neighboring city where she remained four weeks. There has been slight loss in weight. The eyes present all the signs of exophthalmic goitre. The thyroid is symmetrically enlarged. Systolic thrill over thyroid and systolic bruit heard. Pulsation of carotids increased. The lungs are clear. Heart rapid and overactive. Marked tremors. Unable to hold objects.

Blood Examination.—Hb. 85 per cent.; red cells 4,250,000, white cells 7600, polymorphonuclears 82 per cent., S. m. 10. L. m. 4. T. 4 per cent. Blood type 2. Wassermann negative. B.M.R. 46. Urine negative on admission.

October 11, 1924, urine showed very many hyaline and a few granular casts. Pulse on admission varied from 130 to 152. Lugol's solution was administered. There was gradual improvement for three weeks. The pulse ranged from 120 to 130. The nervous symptoms then increased again, and the pulse became more rapid.

October 31, 1924, both upper poles were ligated with silk under local anæsthesia. On the fourth day there was very marked improvement. Two days later there was confusion and finally delirium. She died eleven days after ligation. The pulse was 120 the day before she died.

This patient coöperated unusually well for one so ill with exophthalmic goitre.

Autopsy.—Dr. B. L. Crawford. Peritoneum, pleural cavities, pericardium, adrenals, kidneys, ureters and bladder, liver, gall-bladder, and pancreas, normal. Axillary and pubic hair is scanty and very fine in texture. The thyroid is enlarged. The spleen is considerably enlarged; rather firm. On section the follicles are numerous and enlarged. There are enlarged Peyer's patches in the ileum and numerous solitary follicles in the colon. The mesenteric and retroperitoneal lymph-nodes are enlarged and rather firm. The aorta is small throughout. The thymus (77 gm.): There is a large remains of thymus present, the thickest portion being just behind the upper end of the sternum and which extends down over the pericardium. On section the thymic tissue cuts with little resistance and the tissue is a normal reddish-pink color with no evidence of fibrosis. Thyroid was not removed, but on section the organ was firm and solid, the cut surface presenting a uniform red appearance.

Diagnosis.—Enlargement of the thyroid. Exophthalmos. Large remains of thymus. Pulmonary œdema. Slight hypertrophy of heart. Lymphoid hyperplasia generalized.

Histological Examination.—Sections from the thyroid show a marked hyperplasia of the gland structure, fibrous trabeculæ dividing it into distinct nodules. There is a marked proliferation of the glandular epithelium, the nuclei of which are hyperchromatic, no inflammatory reaction is observed. The thymus is composed largely of small mononuclear cells with very little fibrous tissue stroma and comparatively few Hassell's corpuscles. There is a hyperplasis of the follicles of the spleen and lymph-nodes.

Doctor Klopp remarked that an enlarged thymus is found at autopsy in nearly all cases under forty years of age who die from exophthalmic goitre. Capelle suggested that the severity of the disease was indicated somewhat by the size of the thymus. It is rather difficult to determine the exact size of the thymus by percussion and X-ray examination. Every case of exophthalmic goitre should have an X-ray of the chest to determine the presence of a substernal thyroid and perhaps the size of the thymus. Differential blood counts, as observed by Plummer and others of the Mayo

Clinic, do not differ materially in the fatal and non-fatal cases, if comparatively of the same age. Kocher suggested that leucopenia with relative lymphocytosis indicated a serious outlook. Shridde considered a lymphocytosis of more than 40 per cent. a contra-indication to operation. The old belief that the thymus begins to diminish at two years must be abandoned. There is sufficient evidence that it increases until puberty, after which it gradually undergoes involution. Its enlargement in Graves' disease probably is secondary to the toxæmia, and not a cause of, as claimed by some observers, especially those of the French School. Occasionally there is a recurrence of the syndrome of Graves' disease following resection of the thyroid. Von Haberer claims this may be due to an enlarged thymus. Garré, Von Haberer, and others, have recommended its removal in cases in which thyroidectomy did not afford good results. The suggestion has not been carried out by many surgeons, therefore we cannot draw conclusions on the subject.

RUPTURE OF THE SPLEEN FOLLOWING SLIGHT TRAUMA OR EXERTION

Dr. James H. Baldwin reported the case of a woman, age thirty-four, who was referred to the Methodist Hospital by Dr. E. J. Burton, April 1, 1924. She was admitted about midnight when she was seen by the interne on duty, Doctor Whyte, who reported that the patient had been admitted having symptoms of shock or toxæmia. That she had eaten some potato salad and drank some milk in the evening and later had an attack of abdominal pain with nausea and emesis. He reported that the patient was now resting quietly with some abdominal pain, general abdominal tenderness, but no abdominal rigidity. There had been no history of trauma or illness given. The temperature was 96, pulse 94, respiration 20. The blood picture was: reds 2 million plus, whites 13,000, hæmoglobin 60. The blood-pressure was: systolic 85, diastolic 65. One hour later the temperature was 98, pulse was 88, and respiration 20. The systolic pressure had gone up to 95 and the diastolic remained at 65. This seemed an improvement, as the condition of the patient had not changed otherwise. The blood-pressure rose slowly to systolic 110 and the diastolic remained at 65. There was some pain over the entire abdomen and pelvis. Pelvic examination revealed no palpable pathology. There was pain and tenderness over the left lower chest and pain in the left shoulder and neck. There was marked pallor and slight dyspnœa. There was no air hunger or thirst. There was no abdominal rigidity. There was no special point of tenderness, though the epigastrium was more tender than the rest of the abdomen. There was an indefinite, but not at all positive dulness in both flanks. Several hæmoglobin estimates were made and showed a total drop from 60 to 38. The final leucocyte count at this time was 16,300.

At this time it was learned from the husband that the woman had come home from her work, twelve days before, complaining of severe pain in the abdomen and lower left chest. That she had tried to remove the lid from an ice cream can and that the lid came off suddenly in her hands and the lid struck her in the left upper abdomen. This was followed immediately by pain in this region so severe that she had to stop work at once and was sent to the "rest room." After lying down there for about two hours, she was able to go home, though suffering great pain. No physician was called. She was put to bed, where she remained for the following eight days. The pain was still present but less severe, and she was able to eat and at times was comfortable and free from pain. Her employers having sent word for her to return as soon as possible, although pain was still present, she decided to go back and try it. So on Monday, March 31, she returned to work,

forced herself to keep at it, and worked Monday and Tuesday, having pain continuously. She did her former work of dipping ice cream and the pain was more severe, and especially so on Tuesday afternoon. She remained at work until closing time and went home, where she ate the potato salad and drank the two glasses of milk. Later she had nausea and emesis, and about 10 P.M. had a severe and shocking pain in the upper abdomen. About 11 P.M. her family physician was summoned and she was sent into the hospital at once. This was eleven days after a possible trauma that was seemingly slight and trivial in character.

Operation.—Under light gas-oxygen-ether anæsthesia, a left rectus incision was made. On opening the peritoneum, there was no fluid or blood seen at first, only a normal looking omentum presenting in the wound. When this was pulled down, a large dark organized blood clot appeared and the incision was enlarged. As soon as the clot was disturbed a very profuse hemorrhage was started. The pedicle was grasped in the fingers and held. This controlled all hemorrhage and six clamps were placed on the pedicle close to the spleen. The spleen was cut away and showed a large rupture. During the ligation of the pedicle, the upper clamp was raised slightly to get the ligature under the point. The clamp came away and immediately there was a furious hemorrhage of bright fresh blood. Three large hot packs were placed in the cavity and the remaining five clamps were left on. This controlled all hemorrhage. During this time, 1000 c.c. of citrated blood was transfused from the husband, by Dr. W. R. Gilmour.

Following the operation, the pulse went to 160. The temperature and respiration remained normal. There was no reaction from the blood transfusion. The next day the pulse was 100, temperature 99, and respiration 22. Blood taken at time of operation showed: reds 1,990,000, whites 16,200, hæmoglobin 37. The blood picture improved constantly under treatment and on discharge from the hospital on May 13, the reds were 4,130,000, whites 9600, and hæmoglobin near 60. The clamps and packs were gradually removed and all were out in about ten days. The clamps were all removed several days before the last pack. The patient made a prompt and very satisfactory recovery and has remained well since.

Examination of the spleen shows a large rupture extending deep into the splenic substance. Perhaps there was a small rupture under the capsule at the first pain, which was extended at the time of the second severe pain. The spleen was examined by pathologists at the Methodist, University and Philadelphia General Hospitals as to size, weight and structure, and was pronounced normal.

Dr. Calvin M. Smyth, Jr., said that Doctor Pfeiffer and he had occasion to report before the Academy last spring four cases of traumatic rupture of the spleen. In getting up the material for this report they investigated a good many cases. They were struck with the fact that many of these were the result of very insignificant injury.

Another thing which impressed them, and which has been noted by others, is the long period which sometimes elapses between the injury and the development of symptoms, sometimes as long as twelve days. Since that report last spring he had had two more cases, both with delayed symptoms. One was a boy who fell from a bicycle and struck his abdomen on a railroad track. He was seen by the family doctor that afternoon, who reduced a Colles' fracture and told the boy's parents he was all right. The boy went home, ate a large supper, and then did not feel so well. About eight o'clock he vomited; about 8.30 he had a good deal of pain, and at 9.30 was sent to the hospital. Doctor Smyth saw him at 10.30 and operated at once. He

had an extensive rupture of the spleen with the peritoneal cavity full of blood. In this case it was a matter of hours between the injury and the development of symptoms.

In the other case a boy playing football was tackled and according to his story one of the tacklers struck him in the abdomen with his knee. He was seen soon after by his family physician, who diagnosed a fractured rib on the left side, and strapped the chest. The boy gradually went down hill. Doctor Smyth saw him in consultation with his doctor four days following the injury. At that time he presented the picture of internal hemorrhage. Operation was performed that night. They found a large mass of clots around the spleen with much free blood in the peritoneal cavity. In these cases of ruptured spleen much depends where the injury is—whether in a large vessel or in the splenic pulp alone; if the former, there is a more rapidly developing picture of hemorrhage; on the other hand, with the latter there may be an interval with no symptoms of hemorrhage. All these patients have anæmia following their surgical recovery. Unless the anæmia is actively treated, the blood count remains low. In the last case mentioned by him the operation was done September 24; his blood count on admission to the hospital showed 50 per cent. hæmoglobin, 1,900,000 red cells, and 18,000 to 19,000 leucocytes. Blood transfusion was done immediately following the operation and the count came up temporarily and then dropped. Four weeks after operation when discharged it was up to 70 per cent. hæmoglobin, 3,800,000 red cells and 12,000 leucocytes. Two months after operation, his hæmoglobin was 82 per cent., red cells 4,640,000, and leucocytes 8600; he has had active treatment with iron and arsenic since the operation. His blood picture to-day is perfectly good, but the differential count shows the same thing that they all show, an increase in lymphocytes, with a decrease in polymorphonuclear cells. This gradually should return to normal.

ACUTE INTUSSUSCEPTION IN CHILDREN

Dr. Henry P. Brown, Jr., read a paper with the above title, for which see page 637.

Dr. J. Blechschmidt remarked that in two recent cases which proved to be intussusception, there was no blood, nor bloody mucus.

Dr. W. E. Lee remarked upon the operative technic required in these cases, calling attention to the necessity of routine jejunostomy in these patients to insure the rapid evacuation of the toxic contents of the upper intestinal tract. The value of this procedure in adults with intestinal obstruction has been demonstrated, and it would seem rational to suppose that the toxic deaths which occur in such a large proportion of infants with intussusception, even when the intussusception is completely relieved, would not occur if the toxic substances of the upper intestinal tract were promptly removed.

His method of overcoming the irreducible type of intussusception was new to him. The principle, of course, is the same as that of the division of the constricting ring in an irreducible hernia, the cutting of the constricting prepuce in paraphimosis; the more common procedure of the division of the aponeurotic pillars of the external ring of the inguinal canal, or of the internal ring, in irreducible inguinal hernia. The procedure is such an obvious answer to the problem that one feels sure that it must have been

employed in the past, though certainly it has been forgotten by the present generation of surgeons. If one had thought of intussusception as an irreducible hernia of the bowel, one would probably have employed this method of reducing irreducible hernia before this. This procedure of Doctor Brown's will practically eliminate the necessity of resecting the bowel in irreducible intussusception, except in the few cases in which actual gangrene has taken place.

Dr. J. E. Sweet said that his own feeling concerning the toxine encountered in obstruction of the small intestine is that it is a normal product of the mucous membrane which is going the wrong way. We know, for example, that the tryptic ferment of the pancreas is extremely toxic when it gains entrance into the blood stream, but under normal circumstances we probably never find trypsin in the blood stream. It is as much a foreign protein as are the foreign proteins of our food, because once excreted into the lumen of the intestine it is, in fact, outside of the body, and cannot normally gain entrance to the inside of the body, unless it be broken down into its constituent and soluble parts. In high obstruction the proteolytic ferment of the intestinal mucosa is activated within the cells, and then passes into the lymph stream and the blood stream, and is the toxic agent concerned. These obstructions in children are of the lower small intestine, but I believe there must be a rapid damming-back with consequent upper obstruction.

SWELLINGS OF THE SUBMAXILLARY REGION

Dr. Robert H. Ivy delivered the annual oration before the Academy upon the above topic, for which see page 605.

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